DOCUMENT RESUME

ED 126 314 95 CE 007 445

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TITLE Proceedings of a Symposium on Task Analyses/Task Inventories.
INSTITUTION Ohio State Univ., Columbus. Center for Vocational Education.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
REPORT NO VT-102-987
PUB DATE 75
GRANT OEG-0-74-1671
NOTE 131p.; Symposium held at the Center for Vocational Education, Ohio State University, November 17-18, 1975; Page 121 will not reproduce well in microfiche due to small size of type
AVAILABLE FROM Center for Vocational Education, Ohio State University, 1960 Kenny Road, Columbus, Ohio 43210 (Order Number UN-10, $9.75)

EDRS PRICE MF-$0.83 HC-$7.35 Plus Postage.
DESCRIPTORS Conference Reports; Cost Effectiveness; Curriculum Development; *Job Analysis; Performance Criteria; Performance Tests; *Research Methodology; Speeches; Symposia; Systems Approach; *Task Analysis; Test Construction
IDENTIFIERS *Task Inventories

ABSTRACT

In November 1975, a group of 158 persons met in Columbus, Ohio, to discuss the processes and techniques of job task analysis and the use of task inventories. The papers presented at the symposium are reproduced in this document as prepared by their authors. For the two speakers who did not prepare papers, only references to papers previously published by them are provided. The titles of the papers are: Formats and Strategies in Information Tasks; Task and Content Analysis Methods--An Expanding View; The Job Analysis Technique of the U.S. Employment Service; Functional Job Analysis; The Comprehensive Occupational Data Analysis Program; The Position Analysis Questionnaire: From Theory to Research Practice; Information Mapping: How it Helps Task Analysis; The Marine Corps Task Analysis Program; Occupational Analysis in the U.S. Air Force; The Instructional Systems Model of the Vocational-Technical Education Consortium of States Used to Develop Performance Objectives, Criterion-Referenced Measures and Performance Guides for Learners; The Development of Job Task Inventories and Their Use in Job Analysis Research; Methods for Curriculum Content Derivation; Task Systems Analysis; Job Task Analysis in Text and Test Development; and Task Analysis: The Basis for Performance Tests and Instructional Design. (NJ)

PROCEEDINGS OF A SYMPOSIUM ON TASK ANALYSES / TASK INVENTORIES

Edited by

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1975

FOREWORD

The existence of many job task analysis methods and task inventories is generally not known beyond their immediate origins. This situation leads to needless duplication of effort in developing and using them.

To promote the interchange of information about task analyses and task inventories, a National Symposium on Task Analyses/Inventories was sponsored by the Task Inventory Exchange (TIE) project at The Center for Vocational Education. One-hundred and fifty-eight persons representing the industrial, military, business, governmental, and educational communities in 26 states, the District of Columbia, and Canada showed their interest in the task analyses/inventories field by attending that symposium. They shared their experiences, problems, solutions, and thinking on this important field.

We wish to thank the participants for attending the symposium and extend special appreciation to the speakers for providing the stimulating and informative presentations. The following Center staff are recognized for their efforts to coordinate the symposium. Paul Schroeder, project director; Sunita Saldanha, secretary, Willie Thomas, graduate research associate, and Ernie Wallerstein, student assistant

We hope this publication and the services of TIE will prove valuable in your endeavors.

Robert E. Taylor, Director
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4

TABLE OF CONTENTS

INTRODUCTION

On November 17 and 18, 1975, a group of 158 persons met in Columbus, Ohio, at the invitation of the Task Inventory Exchange, to discuss the processes and techniques of job task analysis and the use of task inventories.

There were two primary and closely related reasons for conducting the symposium. First, the many diverse organizations and persons using task analyses and task inventories for training and performance evaluation should be aware of each other. Second, the information, that is techniques, accomplishments, etc., they possess should be shared. The symposium was, therefore, perceived as a beginning to what is hoped will be a continuing and expanding forum for personal interactions and the interchange of ideas.

The papers in the Proceedings are reproduced as prepared by their authors. Two speakers did not prepare papers. Therefore, only references to papers previously published by these speakers are provided.

The Proceedings is our means of sharing the full text of prepared papers with symposium participants. Also, it is our means of communicating with the people, interested in task analysis inventories, who were unable to attend the symposium.

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FORMATS AND STRATEGIES IN INFORMATION TASKS

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Task Information Archives

A valuable endeavor with great potential significance for personnel sybsystem design, especially if the library is also a repository of developments in the various techniques and applications of task analysis.

Retrieval of Task Information

The purpose of storage is retrieval. Retrieval efficiency and effectiveness depend on selective access to stored content according to purpose of the moment. Subject matter classification structure is the key to selective retrieval, but is must be shared by the operations that classify documents entering the files and the operations for retrieval from the files. Search costs and effectiveness will determine whether the archives are alive or dead.

Classification Systems

Taxonomic structure applied to content in the archives should derive from the purposes that users are expected to have for inquiring into the files. The terms in the classification should ideally link the full range of applicable archival content to the user purpose by means of efficient query structure.

Manual search of several hundred documents to a subject matter query is feasible, but when the file includes thousands of lengthy documents, some form of subject and topic assess via indexing becomes imperative. The following are examples of purposes to which existing task information could be of practical utility.

Design of training customized to requirements of Task X

Design of training to the psychological-learning characteristics of Task X type

Adapt the training package from "similar" tasks already trained

Project performance limits, human errors from Task X to Task X'.

Transfer human factors knowledge acquired about Task X to Task X'.

Estimate transfer capability of man trained in Task X to Task X'.

Transfer selection data acquired on Task X to Task X'.

(Note: Task X may be a laboratory research task!)

Assess potential range of effect from an innovation in training, or a change in task procedure, environment, etc.

Differentiate virtuoso task performance from perfunctory task performance within the characterization of task "requirements."

Develop performance criteria for evaluation of Task X' from Task X descriptions.

Most of these questions boil down to the following: What training technology found applicable to tasks in the archives is relevant to the task at hand? What performance capabilities and errors to expect in a given task configuration? What aptitudes are relevant? What skills will transfer from one task context to another?

Archives should be useful for the transfer of knowledge and findings from previous situations to new situations. The trick is determining which of the old situations and findings are relevant to the one at hand where one wants to design training or task support or aptitudes and to make performance predictions?

A few of us have believed that whatever a "task taxonomy" (ugh!) should do, it ought at least serve practical functions like this rather than academic "structures of performance." Since many purposes are to be served, it is likely that there will be several useful classification structures, each of which represents a model of the major variables and alternatives in a conceptual model of the context, e.g., training, selection, human factors design, etc.

A Schematic of Descriptive Variables

Lacking a more analytic and generalizable behavioral model of tasks, the following may serve as external descriptive rubrics:

Equipment and objects used: tools used. these establish resource relevance to the task and competence in specified resource capabilities.

Environments: the nature of the stress; contingencies; constraints.

Reference information: essential to, say 90% of all task situations. The reference information may be in the operator's head, or he may have to find it and use it, possibly translate it into task operations.

Task operations: performance models, procedures, strategies, handling of concurrencies. Also. scan-detect; identify; interpret, decide; construct; motor action; short term memory retentions.

Criteria of performance: explicit or implicit; lower limits; enabling interactive tradeoffs among criteria, or independent criteria.

Task Formats

A concept enabling a basis for generalizing within a format class with respect to training principles applicable, and expectations of transfer of training.

Applicable to perceptual, perceptual-motor, cognitive activities. Example: Quickness in transferring driver skills from U.S. to Britain in spite of reversals in location of clutch, position of driver, side of road, passing and corner turning patterns.

Format defined: The constants that persist from one task cycle to another. The "constants" are the set of variables relevant to the task situation that characterize (a) the task or service requirement; (b) task reference information; (c) response repertoire.

*Format is the organizer (or the organization) of information context in short term memory.

A classical example of format yielded by a transaction structure:

a. A requisition form requesting a set of wanted objects: the format is contained on a printed requisition "format of variables."

b. A reference file of vendors, objects vended and other attributes (variables) relevant to selecting a vendor: a standard format of reference information in the structure of a table of entries, where each item in a list of entities (vendors) has a set of attributes and attribute values associated with it.

c An order form for creating an order to a vendor: a standard format of output variables in the transaction

d The processing by the buyer in performing the task of translating a requisition to a purchase order consists in applying policy rules and making mental tradeoffs between request variables (demand) and service variables (resources).

Note that "format" emphasizes the classes (variables) of information (input, reference and output) to be processed as a context, or to be processed in context sequences, and somewhat deemphasizes the importance of specific processing operations or rules. In general, the latter can be quickly learned or modified as constrasted with the learning to cope (hold in mind) data contexts.

*Since task format is central to organizing information in short term memory; it is one central factor in generalizations about training; transfer of training range; subsetting and organizing psychological knowledge and principles.

*A by-product of the concept of task format and transaction format:

Intelligent design of data base content and organization to support human tasks by information systems.

Comment. Don't leave data base application design to programmers—it will result in the same mess as info retrieval left to librarians and education left to scholastics. None of these use task reference for system design!

Some Format Types Examined

a. Human control of complex operations: briefing, exception detection, diagnosis, correction of deviation by either reallocation of resource, rerouting of action, or modifying the goal of the work cycle: all of these involving standard task variables to that controller's authority and responsibility.

b. Human Diagnosis—a series of symptom tests leading to a hypothesis that identifies the correctible cause or the choice of a remedial action.

c. Human decision-making—semi-quantitative and qualitative (see the example cited under "Format defined" in a preceding topic).

d System evaluation (what are the system outputs under varying ranges of system inputs and environments) and system optimization (improving efficiency and costs by redesigning pathways, functional nodes and distribution of the system's resources and objectives).

e. Discovery—browsing and hypothesis formation; hypothesis testing and relevant range determination, application.

f. Design and construction (including planning) application of rules and constraints in combining from within resource constraints, a build or action specification intended to serve one or more purposes

Task Strategies

This is the missing ingredient in task studies and training.

Query What variables in the job is the operator trying to optimize?

Examples

Space vs time
Speed vs accuracy
Risk-taking vs security
Efficiency vs flexibility
Short term gain vs long term gain
Etc.

Strategy defined

Policies for making "good" tradeoffs among competing variables;

Policies for optimizing resources for demands, and demands for resources;

According to given outcome criteria, making best use of resource capabilities in an uncertain environment.

Strategy examples

Driving minimizing changes in velocity and direction

Typing separating rate of input from rate of output buffering between input and output.

Diagnosis choosing each next test that maximizes the amount of diagnostic information likely to be provided by the test outcome.

Design from general conceptual layout to specifics, where the hierarchical structure helps designer keep in mind what he is doing and trying to do.

Filing balancing the effort used in putting something away against the effort likely to be spent in retrieving it

Any job: determining criteria of effectiveness (and tolerance limits) in order to establish what actions and information are relevant as opposed to those that are irrelevant.

Conclusion

Useful and exciting work is still ahead in getting further practical insights into task formats and task strategies for comprehending human tasks beyond the robot level of description and analysis. A pragmatic way needs pointing to higher level of human competence as possibilities and hopefully as realizations.

TASK AND CONTENT ANALYSIS METHODS—AN EXPANDING VIEW

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I would like to outline today my views on the field of analysis as I think it exists now. While completing a review of task and content analysis methods, I found a variety of—at last count—28 different methods which are being used prior to instructional design to analyze instructional tasks and bodies of content into instructionally manageable and significant units. Some of these methods were used commercially in private contracting businesses, some of them in military agencies, and some in educational agencies, schools, and colleges. I'd like to outline some of the things that I found as I did this review and then state what I feel the implications are. I won't get into the details of any specific method, but that information is contained in the full version of my paper.

I would like to frame my remarks toward a question which is to be developed later in this conference: "Do we need the Task Inventory Exchange?" Dr. Miller sounded this note in his talk, and I believe it is one of the motivating factors for this meeting to find out what kind of service the TIE can render. I'm not personally connected with the TIE, but I'm very glad to see organizations of this kind that are interested in becoming centers of communication and dissemination for the field of analysis.

I would like to make three points in my talk. The first point is that analysis, as a stage of the instructional development process, is probably the most important—one of the first and certainly the most far-reaching in its effects on other stages. Second of all, I would like to state that a diversity of analysis techniques now exists and that each is suited to a particular purpose. Just as every carpenter has a bag of tools, I think that instructional developers have a bag of tools for analysis, and not all of them have the same function. The third thing that I would like to say is that a categorization of these techniques is possible and that it's probably going to be important to further work in development techniques and may even give us major conceptual tools for dealing with all of the development process in ways we now do not. Let me treat each of my three points separately now.

The first point is that the analysis stage in instructional development process is probably the most important. When we were all college students, the professor drew Bob Glaser's four-box diagram of the Instructional Development process on the board. We have seen different variations on that theme, but all have in common as a first step that you define the objectives or the goals of the system. You define systematically what you have set out to do so that you can tell when you are finished whether you did it acceptably. There are various other processes that follow defining of objectives in the various diagrams of the development process, but that one always seems to be present and right at the first, and Analysis is the process by which we arrive at those objectives.

The first-in-line position of this process coupled with the fact that the product of the analysis becomes an integral part of everything that follows—becomes the main "language" of further work—makes it apparent that a very important product comes out of analysis. If a developer doesn't know how to select media, it might be expensive but it probably won't influence the developed product adversely if the methods used are sound. If a developer doesn't know how to use instructional strategies to build a behavior, then the student can be counted on, as he has in the past, to either detect the critical elements to be learned or learn everything and save the program. But if a man doesn't do a good analysis, then there begin to appear adverse economic, efficiency, program consistency and student interest factors that can add up to failure. A good analysis is a critically important thing.

Because analysis is important to the development process, the development of the field of analysis iteself is important. I believe that we are just stepping out of the Wright Brothers era with analysis techniques. I'm thrilled by Dr. Miller's remark that this is the time for invention in task analysis and development and not yet a time for full dress scientific examinations. I think that we ought to loosen our ties and put our feet up on the desk and armchair a little bit, everyone together. We're emerging from an era, I belive, where every developer had to reinvent the wheel everytime he did an analysis. Groups like this one we are met in today are directing attention to the details of carrying out and using analysis. Soon people who have compared notes on what they do will be able to invent more stable and useful processes than they could when they work alone. And as these people start talking together, they will bring up new issues, and as these issues begin to solidify, there will be a direction formed around which research may coalesce if it is needed. I really think that this is critically important, and don't think that in the past it's been done like it should be. That is why I say that we are just stepping out of the Wright Brothers stages. We are each coming out of the "garage" and everyone is starting to talk together.

I feel that coming out of the "garage" is important because my personal interest extends beyond task and content analysis. I feel that naming effective strategies, making appropriate selections of media, and using efficient yet effective course design and production methods all hinge on the product of analysis. It is a tremendously important thing, yet it is not what we have concerned ourselves with most directly as instructional developers. Let me read you a quote which highlights this misdirection of attention.

> "Studies of teaching have been carried on as though the phenomenon of teaching were well understood. For example, there have been investigations of the attitude of teachers toward their students, studies of permissive and authoritative behavior of teachers and the effects of such behavior, studies of the intelligence of teachers and their knowledge of the subject matter, and inquiries into their personality traits. The failure of such studies to yield a body of consistent knowledge about instruction indicates that perhaps they were premature; that more direct or primative analyses of teaching behavior are needed as a preface to experimental or correlational studies. Furthermore, such factors as personality traits, intelligence and knowledge of instructional content are static elements of teaching behavior indicating nothing about the operations involved in teaching, that is, how concepts, norms, laws, etc. are introduced, analyzed, and manipulated in the course of instruction." (B.O. Smith, M.O. Meux, *A Study of the Logic of Teaching*, U. of Illinois Press, Urbana, 1970, pg. 1-2).

Smith is saying that we have danced around the periphery of the real question. The real question is the interchange of information and attitudes that make up the act of instruction, the moves, the maneuvers, the sequence, not the devices. But that question, to be answered systematically, is linked to the statement of instructional intents and the logical processes for deriving them. This is the kind of redirection of attention that instructional developers are going to have to achieve before they can start applying their trade, and it begins as a question of analysis.

I believe that there are some benefits to be derived from paying direct attention to the analysis process and from developing more sophisticated tools for analysis. I would like to list some. These will be only instructional developer concerns; remember that when Dr. Miller talks about task analysis he talks about it as a part of an entire personnel sub-system of which training is only a relatively minor part. Here are the benefits I see. First, communications about the subject matter during design is facilitated if a language has been formed characterizing the elements of content. Not only does communication proceed more efficiently between members of the design and production groups, but negotiations with clients become more structured as it is possible to name more specifically some of the characteristics of the finished product in terms of content and behavior. Second, it is probable that a language to communicate the properties of content will make the development process itself more efficient and less costly Third, once a language of content and structure is created, the discussion of instructional strategies and the manipulation of materials to reflect various strategy plans will become a better controlled process. Four, the design of tests and evaluation schemes may be assisted when a careful analysis is made of the elements of content. Often the determination of content elements is based upon some theoretical or research premise. Implied by these premises is the method for evaluating mastery of the content. The task he used in evaluating during research also serves as a task for testing mastery. Also, because most methods of analysis categorieze only a few types of behavior the production of objectives is facilitated in the same way that the production of evaluation items is facilitated Fifth, if units of instructional content can be named and related, then the comparison of instructional programs on the basis of content or skills mastered becomes feasible. Sixth, given a stable method of analysis, the assignment of instructional strategies may become more a technology and less a subjective process. Have you even been in the situation where you had all the results of a task analysis and it was your job to turn that into instruction somehow? What did you do? You probably found that the "science" which had brought you that point left you with little to go on with

We really don't know how to talk about strategies, but taking the lead from your analysis, you might consider strategy as a matrix for delivery for content items, and analysis can lead to a description of those items

My second main point is that diverse analytic techniques exist, each suited to a particular application. As I made my review I found there are a number of fields converging on the analysis question, starting to devise plans and methods for analysis that have relevance to the instructional strategy and technique used by a developer. I think that I could name them under about four groups which are all attending to analysis-related problems. First of all, there is a group I would call the Education group. These people are concentrating directly on instructional and training problems and are using analysis as a tool to facilitate the building of learning sequences and the process of instructional design. These people use methods which had their genesis back in the military training effort of World War II. The task analysis is that Dr. Miller has described in his papers, the hierarchical analysis that Dr. Gagne has described in his papers and the variations of each are products of this group, as are more recently certain versions of "information processing" analysis, which attempts to define the mental activity of the learner as he performs a task.

The second group that is converging on the analysis question is what I call the Psychology group. They are the people who try to understand how you learn prose text or rules or just about anything. From their efforts at developing a learning theory a natural by-product is a technique for representing the things to be learned in the currency of the theory. Scandura's learning theory requires us to look at subject-matters as collections of rules. Doing an analysis using this perspective involves identifying that set of rules which best represents the subejct matter. Workers in the area of prose learning characterize a body of information to be learned in terms of its structural and meaningful properties, and they have evolved systems for identifying units of structure and meaning. I believe that one of the end products of any learning theory would be a frame-work within which analysis could proceed.

Still a third group attacking an analysis problem is the Artificial Intelligence Group. People like Marvin Minsky, Herb Simon, and Allan Newell are the most visible representatives of this group. In Artificial Intelligence, the need is to describe a problem to a machine. Additionally, if a machine is to acquire new "information" after it is turned on, someone must be able to describe to the machine what a bit of information is. Out of the solutions proposed to this problem is evolving a language of problem structure and information structure. One major sub group of the Artificial Intelligence group has concerned itself with computer-assisted instruction systems. The SCHOLAR system is an example of a CAI system based on an analytic method which in turn is based on a model of memory.

Finally, I think there is a group of people in private industry who are attacking analysis from the economics standpoint. I know that at Courseware we are very interested in pushing our methods toward improvement, and analysis is one area we give special attention to because of its importance. Unfortunately, some of what is done by private concerns is considered proprietary, so the good ideas of some bright men don't get out to the field and don't get discussed.

I'd like to talk about three analysis paradigms that are used. In my survey it became apparent that there are probably three main themes in analysis right now—three main logics—and a number of variations on them. First, there is the well-known task listing or the task hierarchy. If you are a Bob Gagne follower you start with the task at the top and ask the question "What does a person have to know to perform this task?" Then you iterate the process down to the student's entry level. Another version is the task listing. In this process you take a task and decompose it into constituent parts—phases or stages. I belive this differs from Gagne's method in that it does not support any "psychological" properties exist in the list obtained, whereas a Gagne hierarchy is defined in terms of a psychological principle called "transfer."

A second major analysis approach has been called the Information Processing analysis. To me this is the most exciting. This analysis gets the instructional developer inside of the task. He attempts to determine what mental process a student is actually performing as he performs. If any of you are academics, you know that Lauren Resnick and David Klar, are working on this at elementary learning levels. Paul Merrill has worked with it through his interest in CAI. Dr. Miller's work is very much involved with this paradigm, and when the perspective of time is available, we may see that this is what he has been saying all along. Ed Smith, who is at Michigan State University right now, is doing something which shows how this kind of analysis can be useful. Ed has devised a three-phase analysis which he calls Content Analysis, Task Analysis, and Skills Analysis. In the last phase—Skills Analysis he is actually attempting to flowchart mental processes. You can take, according to Ed's theory, tasks that are very similar and teach them in juxtaposition in such a way that you are teaching not only specific surface content but a mental processing skill also. He is researching this and demonstrating how the first time you teach a task with a given format it takes a certain amount of time but how acquisition of subsequent tasks of similar format takes less and less time. Since the student is not taught the task format directly, he has acquired a cognitive strategy by induction.

The third type of paradigm that I see being suggested is the network. I mentioned the SCHOLAR CAI system which is an artificial intelligence device which operates on a network of information to respond to a student. The idea is very young and although the possibilities are great, the use of this paradigm has been confined to laboratories. I have attempted with some success to apply networks myself and see how network-type relations have been very useful in representing the properties of a subject-matter. The idea is inherent for instance in Dr. Glaser's notion during the heyday of programmed instruction of making a matrix to relate every idea to be covered in instruction to every other idea to be covered. That system has not persisted, but the logic underlying it is far from dead with the network-users. The question is, how does this matrix of relations serve me in presenting sequences of structured content to the student the attention now being toward the structures and less toward the notion of sequence as it was with programmed instruction. Networks also remind us of Ausubel's organizers, and there is likely to be in the future much more use of his ideas as techniques progress.

The final main point that I wanted to make was that a categorization of analysis techniques is possible, and a better categorization is going to be essential to directing work in the area of analysis. To me this is a critical point. To long we've said "We have task analysis, what else do we need? (and remember that when two developers say "task analysis" they probably mean different things). My answer is that I think that we need a good variety of techniques. I think, for example, that we can define three phases of analysis which we go through as instructional developers for a single development project The first is defining the scope of the expected behavior—a job or a body of content and then dividing it into major sub-areas of accomplishment—tasks or main content area divisions.

The second phase I think begins when we do a Learning Requirements Analysis, which is a phrase that Bob Gagne coined In the learning requirements analysis you're not so interested in the gross units of a job or body of information or attitudes; you are interested in breaking things down in terms of the specific lessons you will have to teach a student to lead him step-wise to the final behavior that you want him to have This phase of analysis may consist of the identification of a progression of propositions or models of information, depending on what sort of learning you are trying to promote

Finally you enter a stage of analysis that determines the specific types of displays to which you will expose the student in the course of instruction. That is, those displays or those elements which are going to make up your instructional strategy. This analysis is related to and is a precursor to—but is not the same as designing strategies for instruction.

I think that these three phases of analysis are discriminable in terms of having different process, different outputs, and different uses. Crossed with these phases, I believe it very useful to define a number of "domains" of learning, as they are described by Dr. Gagne, in which you might want instruction to take place There are some times when you want to teach a student how to perform a task, but there are some times when what you want to teach him does not exist as a single, integrated terminal task or body of normally-executed tasks. If you want to teach a class in statistics within the constraints of a college setting, you don't really want the guy just to perform an F—test competently or you don't really want him to just be able to do an analysis of variance. What you really want him to do is to be skilled in making a lot of different technical and procedural decisions. He's got to decide what one to use and then perform it. He is expected to perform tasks and to manipulate a certain body of factual-conceptual data.

In analyzing the tasks and information involved, you are likely to get good direction from more than one type of analysis In this case of statistics, for instance, you are likely to get good—but incomplete results from a task analysis alone. The results of a task analysis will direct you in the teaching of task skills, performing tests, executing procedures, etc. The task analysis, however, will not give you very good tools for dealing with the informational or conceptual dimensions of statistics, the models of information you will give to the students in sequence with the task instruction that hopefully will help him organize his decision making in strange environments and his application of techniques to the appropriate problems. The exact source of help on this second analysis need is not clear, but it is clear to me from my own experience that task analysis alone is not sufficient.

Dr. Gagne's domains make it possible to separate these main areas of concern for analysis. He describes them as domains of learning, each requiring a different set of circumstances for instruction to take place They are Cognitive Strategies, Attitudes, Motor Skills, Intellectual Skills, and Verbal Information Assuming that these domains can be crossed with the phases of analysis—which is done only to suggest possibilities—then some questions arise as to which analysis tool now existing you use for which purpose, and what purposes there are for which no analysis tool exists. What kind of analysis do you perform, for instance, for determining the training requirements for attitudinal behaviors?

For identifying the displays to be used in Motor Skills instruction? For analyzing the major components of Verbal Information the student must master and be able to manipulate during performance? It turned out after my review when I had made this table of analysis phases and learning domains that many spaces were nearly empty, while others were quite crowded. This suggested to me that our attention to the problem of analysis has been too narrowly confined. I suggest that some benefits may be obtained by looking at the broader picture of analysis not only from the standpoint of organizing the work of analysis for those whose job it is to perform it, but also to direct our efforts toward those areas where a need exists but has not been exploited.

As a conclusion I would like to extrapolate to the future from the past. In about 1930 Ralph Tyler emphasized that instruction should be based on instructional objectives. Later Benjamin Bloom agreed and added that he felt that all objectives were not unique and that some method of categorization should be possible, which he supplied. Then Gagne agreed with that and, using his own particular categorization scheme, he demonstrated that an unbiased method of deriving objectives—hierarchical analysis—could be devised to guide the activities of the developer. Perhaps the next development in this sequence of events will be to recognize that different analytic tools can be applied successfully and usefully to different problems and that as there were certain categories of objectives there are certain categories of analysis, each useful to the developer on specific types of analysis problems.

To return to the question asked early in this paper—one of the main questions of this conference "Do we need the TIE?" The answer must be "yes." Because of its importance in the development process, analysis is one of the keys to improved technique and more effective products. Centers like the TIE should make it their business to open communication between interested parties on analysis matters. They should stimulate the development of needed analysis methodologies and encourage the comparison of existing ones. The returns to be had by the developer's profession from TIE's playing such a role is more than enough to justify its existence, and hopefully the TIE's activities in this direction can grow.

THE JOB ANALYSIS TECHNIQUE OF THE UNITED STATES EMPLOYMENT SERVICE

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I. Introduction to the Occupational Analysis Program

A. The United States Employment Service was created by the Wagner-Peyser Act of 1933. It pulled together the several state employment agencies that had been created since the beginning of this century and created agencies in states that had not yet formed one.

B. Local offices came into being all across the country to provide unemployment insurance benefits and employment opportunities to unemployed workers. It soon became apparent that there were communication problems between these offices when they talked to each other about jobs. This was a problem of national importance because workers moved between cities and even to other parts of the country seeking work, based on employment service recommendations. If these recommendations were based on confused information, it could do great hardship to both the worker and the employer.

C. Therefore, in 1935, The United States Employment Service developed a Comparability List of Occupational Titles, which provided a list of standard titles for use by all local offices. This was still unsatisfactory, because the titles were not defined, so different kinds of work might still be identified by the same standard term. It was finally decided that a research program should be established to study jobs in our economy and provide standard titles and definitions of them.

1. The Occupational Research Program of the United States Employment Service was initiated in the mid 1930's. An advisory program composed of individuals with experience in personnel and occupational research work were designated as the Technical Board for the Occupational Research Program of the United States Employment Service.

2. A "job analysis methodology" was devised and developed in a series of instructional manuals for internal use over approximately a ten-year period.

3 In 1939 the first edition of the *Dictionary of Occupational Titles* was published.

4. In 1944, a basic *Training and Reference Manual for Job Analysis* was published. This manual and its revision in 1965 served as the guide for collecting and recording source data and applying the necessary job analysis techniques.

   The *Handbook for Analyzing Jobs*, published in 1972, is the current bible of our program.

5 The job analysis techniques developed in the early stages of the program were a product of the economic situation, that is, a surplus of qualified workers and a shortage of jobs.

a) Data emphasized the tasks of a job (what, how, and why) and little emphasis was placed on the characteristics required of the worker.

b) Only 3 items—(1) experience, (2) training, and (3) performance requirements (responsibilities; job knowledge; mental application; and dexterity and accuracy) on the Job Analysis Schedule referred to the qualifications a worker must bring to the job.

6. A drastic reversal in the economy by the 1940's caused a scarcity of workers and a surplus of jobs needing to be filled.

7. Employers in the 1940's needed data on the characteristics or traits which an applicant should possess in order to learn a job..

a) Entry or less-than-qualified workers became important as a labor market resource —the system needed to evaluate jobs and worker's potential on the basis of personal requirements.

b) The Job Analysis schedule was expanded to include (1) a form for recording the Physical Demands of jobs and (2) a Worker Characteristiacs Form for recording the "personal traits" required of the worker.

c) In 1944, a first attempt to provide personal traits information was provided by Part IV of the first edition of the *Dictionary of Occupational Titles.*

This Document was entitles "Entry Occupational Classsification" and was developed for use in counseling and placing entry workers. Jobs were analyzed and described in terms of ersonal traits."

d) In 1949, two important things happened. (1) The second edition of the *Dictionary of Occupational Titles* was published. (2) A project was initiated for the development of a new classification system for jobs that would reflect what the worker does and the requirements made on him. Several experts in counseling and work classification met to categorize, define, and standardize traits required of the worker. Manualize techniques and instructions for determining Work Performed and Worker Traits requirements were developed. This became known as the Functional Occupational Classification Project.

e) In 1956, *Estimates of Worker Traits Requirements for 4,000 Jobs as Defined in the D.O.T.* was published. This document was a result of several years of research in attempting to characterize jobs in terms of important worker traits. I will speak about the worker traits in detail at a later time.

f) During the research for the first and second editions of the *Dictionary of Occupational Titles* field centers were set up in several states to collect the necessary data. After each edition, the field centers were disbanded In 1955, it was recognized not only that a third edition of the *Dictionary of Occupational Titles* would be necessary, but also that occupational change was constant, so it was determined that field centers should be established on a permanent basis. By 1958, several field centers were established and beginning field research for the third edition, which was published in 1965. Since 1963, research has been going on in preparation for the fourth edition, which we expect to publish in 1976, as a part of the Bicentennial celebrations.

D. Where We Are Now In Terms of A National Program - field centers were set up in 1958.

1. Currently there is a national office in Washington, ten Occupational Analysis Field Centers and one Special Project Center. I have prepared a list of the centers, their addresses, phone numbers and supervisors for you to keep.

2. All field center efforts are focused now on the final review of the materials (job definitions and worker traits ratings) for the 4th edition of the *Dictionary of Occupational Titles*. The main work is currently being done on a monthly or bi-monthly basis in Raleigh, North Carolina by selected field center analysts.

II. A specific method of job analysis in the employment service.

A. In the U.S. Employment Service, job analysis is currently defined as that activity which is involved with:

1. Determining what a worker does in relationship to data, people, and things (worker functions). Item No. 5 on Job Analysis Schedule.

2. Ascertaining what methodologies and techniques are involved in the work (work fields). Item No. 5 on Job Analysis Schedule.

3. Defining the materials, products, subject matter, or services involved in the operations (MPSMS). Also in Item No. 5.

4. Identifying the requirements made upon the worker (worker traits). Item No. 6 on Job Analysis Schedule.

5. Specifying the machines, tools, equipment, and work aids used to achieve the work objectives (MTEWA). Item No. 13 on the second page of the Job Analysis Schedule.

B. In order to meet the requirements for a complete analysis of a "job," the above mentioned categories of information must be obtained and recorded on the Job Analysis Schedule where I have indicated, and must be stated or implied in the job description. Let us start first with worker functions.

1. WORKER FUNCTIONS

a) All job-worker situations involve a relationship to data, people, and things to some degree. We express these relationships by 24 worker functions which are arranged in a hierarchy—the lower the identifying number, the higher the level of worker involvement.

b) The definitions for data, people, and things, and for their respective functional levels, can be found in Volume II of the *D.O.T.* or in the *Job Analysis Handbook*, both of which are listed in a bibliography available to you on the table. First, we determine the level of worker involvement for each function.

c) When a job requires a significant relationship to one of the functions for data, people, and/or things, it is circled on the Job Analysis Schedule and will be reflected as significant in code used for the *Dictionary of Occupational Titles*.

d) The worker functions ratings are reflected in the last three digits of the six digit code used for every occupation listed in the *Dictionary of Occupational Titles*, Third Edition.

e) In order to determine whether or not a function is significant, we consider the following factors.

   (1) The amount of time the function represents in the job - if it is present most of the time, it is probably significant.

   (2) Whether the function is critical in the opinion of the employer. This is determined by asking the employer what function he is really paying for. In the case of a skilled machine operator, the employer is usually paying for the worker's ability to analyze or compile data from blueprints, etc. and for the worker's knowledge and ability to set up the machine.

   (3) The higher the level of the worker function, such as 0, 1, 2, or 3, the greater the likelihood that it will be significant. This may be true even if the function is present a small portion of the time. For example, setting-up is significant for the skilled machine operator, even though he/she spends most of the time watching the machine run after setting it up.

2. WORK FIELD

a) Specific work methods used in the execution of job tasks are referred to as work fields. Each work field is characteristic of:

   (1) The machines, tools, equipment, or work aids that are used to achieve a common technological objective.

   (2) Those techniques that are designed to fill a particular socioeconomic purpose.

b) There are 100 work fields which appear in twenty-eight groupings, arranged on the basis of their similarities in technological or socioeconomical objectives.

c) They cover the acquiring of materials and the manufacture of products or the processing of information or the providing of services.

d) The more general work fields are defined, whenever possible, in terms of the simpler ones which are related to them. For example, Structural Fabricating-Installing-Repairing is defined as a combination of work fields which includes Abrading, Nailing, Riveting, Welding, etc.

e) Jobs are frequently observed which involve techniques that are covered by several work fields. In such instances, a work field is chosen that characterizes the primary function of the job. However, a subsidiary work field may be listed.

3. MATERIALS, PRODUCTS, SUBJECT MATTER, AND SERVICES (MPSMS)

a) MPSMS is found directly below the work field area in Item 5 on the Job Analysis Schedule. The source of entries for this component can be found in the MPSMS groupings in the *Job Analysis Handbook*.

b) The MPSMS organization is a list of categories that are derived from commodities groupings in the *Standard Industrial Classification Manual* and from Educational Classifications of subject matter fields.

c) There are approximately 580 categories, which are organized into 55 major groupings.

4. WORKER TRAITS - INCLUDES ALL OF ITEM NO. 6 ON THE JOB ANALYSIS SCHEDULE

In any work situation, there are certain requirements made by the job upon the worker. These requirements are known collectively as worker traits, and encompass the concepts known as training time, (GED & SVP), Aptitudes, Temperaments, Interest, Physical Demands, and Environmental Conditions.

Let us look at each worker trait separately.

a) TRAINING TIME is made up of two parts: (1) General Educational Development (GED) and (2) Specific Vocational Preparation (SVP).

(1) GED (General Educational Development)

(a) Although GED is related to the amount of formal education received, it must not be though of merely as the attainment of a certain number of "years of schooling" required to perform a particular job. The entire life-of-learning experience must be considered in the evaluation of GED.

(b) Three fundamental skills are delineated in GED:

(1) Reasoning, (2) Mathematics, and (3) Language expressed as six levels of increasing complexity and difficulty with Number 1 being the least complex and Number 6 the most complex. It is possible to estimate what GED level is required for "average successful performance" on any job by comparison of the job being studied to pertinent benchmark work situations which are found in the *Job Analysis Handbook*. Each of the three factors should be considered independently of the of the others in evaluating the level required for a job.

(c) Reasoning development will be present to some degree, in all jobs. However, if a job involves computational work, for example, the mathematical development required to perform the job will be an important aspect along with reasoning.

(2) SVP (SPECIFIC VOCATIONAL PREPARATION)

SVP is also discussed in the *Handbook*.

(a) SVP is the total training and practice time it takes to arrive at average performance on a specific job. Usually, the more complex the job is, the longer that time will be.

(b) Items a through e of No. 8 Vocational Preparation, on the second page of the Job Analysis Schedule, details the different kinds of circumstances under which the preparation may be acquired. The time spent in General Education Development (GED) is not considered in estimating SVP.

(c) You can see a definite progression in the amount of vocational preparation needed to arrive at average performance for any of the jobs. It is important to know that the ratings of SVP do not always parallel the ratings of GED for the same jobs. For example, a chef has an estimated GED level of a 4 but an SPV level of 9.

b) APTITUDES - DISCUSSED IN THE *HANDBOOK*

(1) When we speak of aptitudes for our job analysis purposes, we are not referring to the general aptitude potential that a person may possess, but to an estimate of the actual aptitude capacity present in a worker or required by a job. Worker trait aptitudes are "specific capacities and abilities required of an individual in order to learn or perform adequately a job task."

(2) Please do not confuse this system with the aptitudes as potential abilities which are measured by the General Aptitude Test Battery (GATB).

(3) The basis for our aptitude estimation is the estimated amount of aptitude that is required, from each of eleven factors, to perform a job.

G	-	Intelligence:	V	-	Verbal Aptitude:
N	-	Numerical Aptitude:	S	-	Spatial Aptitude:
P	-	Form Perception:	Q	-	Clerical Perception:
K	-	Motor Coordination:	F	-	Finger Dexterity:
M	-	Manual Dexterity:	E	-	Eye-Hand-Foot Coordination:
C	-	Color Discrimination.			

(4) We are going to think of aptitude levels as the abilities of fraction of the working population.

Let's say 1/3 has low aptitudes, 1/3 has medium aptitudes, and 1/3 has high aptitudes. Now, let's cut off 10% of the whole population on one end and call that very low aptitude. We'll do the same thing on the opposite end and call it very high aptitude. Now we have five levels (roughly 10%, 23%, 33%, 23%, and 10% of the working population).

(5) For identification purposes, very high aptitude requirement will be Number 1, high aptitudes Number 2, medium aptitudes Number 3, low aptitudes will be Number 4 and the very low aptitudes will be Number 5. This results in a bell curve distribution. Be aware that, in our program, an aptitude rating of 5 (the very low level) usually means that the ability is not present in the job in any significant degree and therefore, not required.

c) TEMPERAMENTS - EXPLAINED AND ILLUSTRATED IN THE *HANDBOOK*

(1) Temperaments, as a component of worker traits, grew out of the belief held by many counselors and placement people that different jobs seem to call for different temperament traits.

Temperaments are the abilities to adjust to certain kinds of work situations. They differ from interests, which are positive preferences for certain kinds of work situations. One needn't be interested in a kind of work to be able to tolerate it.

(2) Job placement experience indicates that the "Temperament" of an applicant is often a determining factor in success on a job—that a person's dissatisfaction, failure to adjust, or lack of success may be attributed to a temperament factor.

(3) It is important to be able to recognize in jobs those situations that will impose themselves upon a worker's intrinsic nature and personality qualities. Ten such factors have been identified as significant temperament qualities in job performance.

d) INTERESTS ARE EXPLAINED AND ILLUSTRATED IN THE *HANDBOOK*

(1) Interests are "preferences for certain types of work activities or experiences, with accompanying rejection of contrary types of activities or experiences." Interests are a significant component in occupational classification because:

(a) Numerous studies have indicated a significant correlation between job stability and satisfaction and positive interest in the type of work.

(b) The chief investigators of interest indicate that interests are relatively stable subsequent to adolescence.

(2) Our system is based on interest factor studies, especially those of William C. Cottle, which suggest that interest factors are Bipolar in nature, that is, a positive preference for a type of work is generally associated with a dislike or rejection of a contrary type of work.

(3) Interest experts believe that most jobs require characterization by at least two factors to express adequately the interest pattern of the work situation. Therefore, jobs have been rated by at least two interest factors, and sometimes more in order to show an interest pattern—refer to the Job Analysis Schedule. For example, a job such as a Material Handler would be rated 1a - a preference for activites dealing with things and objects and would probably not be rated for 1b - a preference for activities concerned with the communication of data. These two interests would normally be exclusive of one another.

e) PHYSICAL DEMANDS FACTORS—TURN TO THE LAST PAGE OF THE JOB ANALYSIS SCHEDULE. THESE FACTORS ARE EXPLAINED AND ILLUSTRATED IN THE *HANDBOOK*

(1) During the Analysis of a job, it is first determined whether any of the physical demands factors are present. If a factor is present, we then determine how much of the worker's time is involved in that factor. If the worker spends up to 1/3 of his time on a factor, an O for occasionally is entered on the form; if he spends from 1/3 to 2/3 of his time, an F for frequently is entered; if he spends 2/3 or more of his time, a C for constantly is entered. For example, if a worker spends 80% of his time reaching for and handling tools, we would then place a C for constantly in Item No. 4.

(2) In addition to determining the amount of time the factor is present, we also determine whether that factor is critical to successful performance on the job. We make that judgment on the frequency of presence or the importance of the factor. If it is critical, we circle the factor on the bottom of the form and on p. 1 of the Job Analysis Schedule.

(3) If factors require comments, they are annotated on the right hand side of the schedule.

Obviously, physical demands are very important in reflecting the total requirements of a job. A careful and thorough analysis of these physical demands is essential for those people using th information for job counseling, placement, and devising training programs, especially for handicapped persons.

f) ENVIRONMENTAL CONDITIONS OR WORKING CONDITIONS—THE LAST WORKER TRAIT COMPONENT, REFLECTED ON THE LAST PAGE OF THE JOB ANALYSIS SCHEDULE AND EXPLAINED IN THE *HANDBOOK*

(1) Here again each factor is noted for being not present or if present in the job, whether it is occasionally, frequently, or constantly. Again, we determine if a factor is critical to successful performance and circle the factors at the bottom and on the front.

(2) Protective clothing and personal devices the worker wears/uses are also noted. This concludes our discussion of worker traits.

5. The last major kind of information to be collected relates to the machines, tools, equipment, and work aids used to achieve the work objectives. Turn to Item No. 13 on p. 2 of the Job Analysis Schedule.

   a) Each component is listed separately—that is, all machines together, etc. It is extremely important that these items be identified as it may be crucial to the job duties and requirements that a worker be able to operate various machines, pieces of equipment, etc. A complete definition of each of these components may be found in the *Handbook*.

6. We have completed a brief discussion of the 5 categories of information which must be obtained for a complete analysis of a "job," as defined by the U.S. Employment Service. They are: 1 - Worker Functions, 2 - Work Fields, 3 - MPSMS, 4 - Worker Traits, and 5 - MTEWA. Besides rating the jobs we study for these kinds of information, we use this information when writing a detailed description of each job, to insure that our job descriptions treat all important characteristics of the work.

C. TASK DESCRIPTIONS—Item No. 15 on the 3rd page of the Job Analysis Schedule.

   1. We have our own method of presenting and writing tasks for job definitions. Our technique permits the most complex job-worker situation to be stated in brief declarative sentences.

a) The usual organization of our sentences includes: An implied subject, a verb, its object, a modifying infinitive and its object.

b) The subject is always the worker. It is always understood and is not included in the sentence.

c) An action verb usually begins the sentence. This verb indicates the actions the worker is taking.

d) The second part of the sentence is the object of the action verb.

(1) If the worker is involved with data, the object of the verb will be information in some form.

(2) If the involvement is with people, the object will be people to whom a service is usually being rendered.

(3) If the worker is involved with things, the object will be a machine, tool, equipment, or work aid through which the action of the verb is discharged.

e) The action verb and its object is usually then followed by an infinitive which indicates the object or purpose of the worker's action.

f) An object of the infinitive which is usually some form of material, product, subject matter, or service.

g) Tasks are separated, numbered and followed with an estimate of the percentage of time spent by the worker on each and recorded in Item No. 15 of the Job Analysis Schedule.

2. Preparation for publication in the D.O.T.—one of the main products of our research is the *Dictionary of Occupational Titles.*

To prepare our material for this publication the Job Analysis Schedules are combined and prepared in a new format as an occupation definition.

III. USES OF JOB ANALYSIS AND THE SERVICES WE PROVIDE

A. Some of the uses of job analysis as developed by the U.S. Employment Service are:

1. Recruitment and Placement

Providing meaningful and correct job data for the recruitment and selection of workers.

2. Better Utilization of Workers

a) Establishing job relationships that can be used to transfer and promote workers in order to develop job opportunities at the entry level.

b) Delineating the physical demands of jobs, and suggesting job adjustments that will facilitate the use of handicapped workers and other special interest groups.

3. Job Restructuring

   a) Accommodating new work processes within an establishment.

   b) Making better use of the available work force.

   c) Assisting in the creation of entry job opportunities for the less-than-fully qualified.

   d) Facilitating the placement of workers in hard-to-fill jobs.

   e) Designing new positions for trainees.

4. Vocational Counseling

   Furnishing the vocational counselor with a guideline for vocational counseling by presenting accurate descriptions of the tasks and requirements of jobs, and the training, experiences, or avocations that lead to them.

5. Training

   Determining training needs and developing training programs, especially on-the-job training programs.

   The content of the training curriculum, time required for training, and selection of trainees are dependent, in part, upon thorough knowledge of jobs.

6. Performance Evaluation

   Providing an objective basis for developing performance standards.

7. Plant Safety

   Improving plant safety by disclosing job hazards.

8. Job Evaluation

   Providing an objective basis from which to develop job evaluation standards.

B. The documents on our table represent some national efforts—3rd Edition *Dictionary of Occupational Titles*, Volumes I and II, job restructuring pamphlet, etc. In addition, I have included a sample industry study which includes staffing schedules, job analysis schedules, job definitions, flow and organization charts, and a narrative report. Also, the Bureau of Hearings and Appeals, Social Security Administration, requested that our center study low training time and light physical demands occupations for use the adjudication of disability claims cases. A copy of one of these studies is available for your review. Please do not permanently remove any of these materials from the table.

C. In addition, there are copies of the following materials which you may keep:

   1. A list of the services and types of information we provide.

2. A bibliography of some pertinent documents published by the Department of Labor, Manpower Administration. The prices and address to contact are listed on the bibliography.

3. The names, addresses, and phone numbers of the Occupational Analysis Field Centers, Special Projects, and the National Office in Washington. Feel free to contact any of these centers if you have questions or problems and you believe they may be of assistance in resolving them.

D. We, in Michigan, may be contacted for formal job analysis training sessions. These sessions usually cover the main areas of the entire job analysis program, including how to conduct an industry study, how to prepare a staffing schedule, a complete job analysis schedule, and a narrative report. Negotiations for this training may be made with us. It is free of charge and is scheduled according to our center work-load.

FUNCTIONAL JOB ANALYSIS

Sidney A Fine
Sidney A Fine Associates, Inc.

Fine, Sidney A., Ann M. Holt, and Maret F. Hutchinson. *Functional Job Analysis. An Annotated Bibliography*. Methods for Manpower Analysis; No. 10. Kalamazoo: W. E. Upjohn Institute for Employment Research, 1975. (75 cents; 300 South Westnedge Ave., Kalamazoo, MI 49007).

This document will refer the reader to 83 publications which provide a chronological survey of the development, growth, and application of the functional job analysis concept from 1951 to the present.

THE COMPREHENSIVE OCCUPATIONAL DATA ANALYSIS PROGRAM (CODAP)

Raymond E. Christal

United States Air Force Occupational Research Division

Christal, Raymond E. *The United States Air Force Occupational Research Project.* Lackland AFB: Air Force Human Resources Laboratory, January 1974. (Report No. AFHRL-TR-73-75; *NTIS Availability: AD-774-574/8GI).

Archer, Joann R., and M. Joyce Giorgia (eds.). *Bibliography of the Occupational Research Division, Air Force Human Resources Laboratory (AFSC).* Lackland AFB: Air Force Human Resources Laboratory, July, 1974. (Report No. AFHRL-TR-74-56; *NTIS Availability: None stated).

These two publications provide the reader a well documented explanation and history of the CODAP system.

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THE POSITION ANALYSIS QUESTIONNAIRE (PAQ): FROM THEORY TO RESEARCH TO PRACTICE

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To gain a complete picture of the Position Analysis Questionnaire this paper has been divided into three sections dealing with (1) the theoretical underpinnings suggesting the development of the PAQ, (2) the research done with the PAQ, and (3) the practical procedures for using the PAQ at present.

Supporting Research and Theory

The idea that there are differences among people which lend themselves to particular occupations is of ancient origin. Plato expressed the notion as follows: "I am myself reminded that we are not all alike, there are diversities of natures among us which are adapted to different occupations."

The systematic investigation of the relationship of human characteristics to job characteristics is apparently of more recent vintage. From the investigations of Galton, Binet, Cattell, and others, both the confirmation of the concept of individual differences emerged as well as the implication that at least some human characteristics could be identified, quantified, and used to allocate human resources where the contribution proved greatest (Linden and Linden, 1968). The finding, for example, that people in the same occupation tended to have aptitude and ability scores more nearly alike than the general population (Harrell and Harrell, 1945; U.S. Department of Labor, 1967) offered further support to the idea. That factors in addition to the aptitude and ability domain were also present has been confirmed by Strong (1943) and others who have found a tendency for persons in given occupations to be more alike in terms of interest than is the general population.

From this very brief review of history one may conclude the following:

A. Individual differences in aptitude, ability, interest, and other domains do exist and are frequently of considerable magnitude.

B. Jobs present requirements that are better met by persons possessing compatible characteristics, and because of the rewards associated with compatible relationships, people will selectively migrate from jobs of less compatibility to those of more compatibility and/or attempt to make changes in the job or themselves; and,

C. The movement of human resources to the points of optimal utilization and personal satisfaction can be accelerated by identifying both relevant human and job characteristics and arranging for a compatible relationship through person-job matching, or, where possible and desirable, alteration of either human of job characteristics.

The foregoing historical sketch and the conclusions therefrom are, of course, not new to the industrial psychologist and others who have attempted to improve on the match between people and jobs. This is evidenced by the considerable effort that has been expended in the areas of test development, standardization, and validation. Nor have attempts to understand the characteristics of jobs been on a small scale as evidenced by the work of conference participants, the United States Bureau of Labor with its *Dictionary of Occupational Titles* (D.O.T., 1965), and others. However, with the advent of modern statistical and psychometric methods and the high-speed computer, one's perception as to what is possible has been gradually modified. The confluence of the theory accompanied by an increasing technical capability to realize its application has led to a number of experimental attempts at person-job matching. The remainder of the paper will focus on the research conducted by E. J. McCormick and his students at Purdue University from the late 50's to the present, as well as contributions made by a number of other investigators.

Development of the PAQ

Describing the Job

One major problem in matching people and jobs has been the difficulty associated with obtaining reliable descriptive material about jobs in a form which could be related to data about people. While the data about people could often be collected and presented in numerical form, job descriptions were usually of a written nature, thereby prohibiting the use of statistical procedures to discover relationships between people and job data. Several earlier attempts had been made to quantify job data by having raters judge the degree to which the job required certain human characteristics (see, for example, the Job Psychograph by Viteles, 1932; the J-coefficient approach by Primoff, 1950, 1955, 1957, 1959, and trait ratings found in Volume II of the D.O.T., U.S. Department of Labor, 1965). While such a rating approach often yielded reliable data, the usefulness of the data was often less than that desired as the ratings often did not correlate very highly with the measured characteristics (particularly psychomotor) of persons performing the job (Trattner, Fine, and Kubis, 1955; Mecham and McCormick, 1969). It seemed that the research dictum that people are relatively good observers but relatively poor at determining what the observations mean had as much relevance here as elsewhere. This led quite naturally to the conclusion that a rating methodology which yielded numerical data should be focused on the recording of what could be observed or easily implied from observable sources, and that what it meant should be relegated to statistical procedures capable of more accurate and complete analysis than what the rater could offer.

While in theory one could construct a checklist to describe every type of job activity, in practice such a checklist would be burdensome to construct and use if jobs of divergent composition were to be considered in a single checklist. Nor would such a checklist be immune to the ravages of changes in jobs brought on by technology and job redesign. One is left then with a dilemma: how does one utilize the observational superiority of the human rater by limiting the rating task to the recording of observations and at the same time utilize the data analysis capabilities of modern statistical and computer procedures to determine the relationship between human and job data. Furthermore, it must be done in a practical way such that it is applicable to jobs of many types. One possible compromise solution was offered by McCormick (1959) in terms of the "worker-oriented" job element. Briefly, the reasoning is as follows. (A) there are a limited number of elemental behaviors in which any person can engage, with the number of these behaviors being limited by the biological characteristics of the human being, and (B) these behaviors may be exhibited in a variety of technological contexts, but the types of physical and mental behaviors in the human repertoire remain constant across jobs and throughout changes in technology. Thus emerged the concept of the "worker-oriented" job element. Many of you will recognize a kinship with the "elemental motion" idea from Time and Motion study. The worker-oriented job element was generalized, however, to include the entire behavioral repertoire of the human being

Once this concept was theorized, work proceeded to define the worker-oriented job elements. As a starting point, the familiar Stimulus-Organism Response (S-O-R) model of behavior was adopted as a framework for identifying these elements. For example, from the stimulus side of the model, the various senses used in observing stimuli were noted (i.e., vision, hearing, smelling, etc.). The task then became one of identifying job behaviors which required use of one or several of the senses. Likewise, various reasoning, decision making, and other mental processes were cataloged under the "Organism" section of the model while the "Response" section dealt with psychomotor aspects of the work including the types of tools typically used on the job. In addition, items were developed covering the social and physical context in which the job was performed. The process of defining the range of items to be used and refining the individual items has been an evolutionary one, having begun with the early work in the late 1950's and continuing through to the present time (McCormick, Jeanneret, and Mecham, 1969).

Determining the Relationship of Job Data to People Data

Once a structured job analysis instrument had been developed (the Position Analysis Questionnaire), it became possible to statistically explore the possible relationships which might exist between jobs and the people who are attracted to and perform those jobs. Was there, for example, a predictable relationship between certain job characteristics and certain aptitude and ability characteristics as implied by the concept of synthetic validity (also referred to as indirect validity, generalized validity, and job component validity). This notion, as stated by Balma (1959), involves the following: "The inferring of validity in a specific situation from a logical analysis of jobs into their elements, a determination of test validity for those elements, and a combination of elemental validities into a whole."

Was it now possible that factors such as vocational interest known to be associated with the person-job match could be identified and investigated in much the same? Would it also be possible to find the relationship of job characteristics to wage and salary levels and formalize a new method of job evaluation? Could jobs be classified, creating job families and combining similar jobs under the same title? According to their similarities, could one find the particular characteristics associated with jobs which tend toward worker satisfaction or dissatisfaction?

In a word, yes. Each of these relationships could be and have been explored. In brief, the research in each area may be given as follows.

Synthetic Validity. Mecham and McCormick (1969; see also, McCormick, Jeanneret, and Mecham, 1972) found strong multiple correlations between mean test scores for job incumbents on the General Aptitude Test Battery (GATB) and PAQ factor scores. For the 90 jobs studied, the coefficients ranged from .60 to .80 for tests of a cognitive nature and from .48 to .71 for psychomotor tests. Weaker but good multiple correlation coefficients were also found in predicting validity coefficients, the standard deviation of test scores for job incumbents, and the usability of the tests in a final test battery for selecting job applicants (McCormick, Mecham, and Jeanneret, 1973). These results have been supported by the later investigations of Marquardt and McCormick (1974).

Vocational Interest. In 1972 the PAQ was modified to determine how attracted to or tolerant of various job characteristics a person was. Rather than indicate the degree to which each element was found on the job, the person was instructed to "... indicate the level of your interest in the activity or situation as a part of any job that you might consider." The resulting instrument (later named the Job Activity Preference Questionnaire—JAPQ) was found to have acceptable reliability (Harris, 1971), and in an unpublished study with high school students was found to predict relatively well their gradepoint averages ($r \approx .50$). Later, Peterson (1974) found in a comparative study that university student gradepoint averages could be predicted as well or better with JAPQ data as with data from the Strong Vocational Interest Blank. Another study indicated that the closer the match between a person's JAPQ data and the characteristics of his/her job as measured with the PAQ, the higher the preference for the job (Longhurst, 1973). Job satisfaction was found to be related to both the level of certain

41

JAPQ and PAQ factors and D^2 differences between them on the job in a study by Calitz, Hilaael, McCormick, and Peters (1974). This followed similar findings by Pritchard and Peters (1973) with a large sample of enlisted naval personnel.

Job Evaluation. As one goes through the PAQ, it is easy to observe many of the types of factors which have been used to assign jobs various rates of compensation. With this view in mind, PAQ data were correlated with going rates of pay on 340 jobs (Mecham and McCormick, 1969; McCormick, et al., 1972) and considerable predictability resulted with multiple correlation coefficients in the mid to high .80's. From this early work, studies were conducted with the U.S. Navy (Harris and McCormick, 1973) and in civilian organizations (Robinson, Wahlstrom, and Mecham, 1974) in which regression equations were used to predict the compensation rates for various jobs. In brief, the rationale was to "capture," using a multiple regression approach, the relationship between job characteristics and going rates of pay, either as found in a general labor market area or in a given organization. Then, the relationship derived (in equation form) can be used to extend the compensation policy to other jobs found within an organization. At present, such a method has been or is being used in a number of organizations. A word of caution is in order, however, before leaving this subject. It has been relatively difficult to "capture" the underlying relationships between job characteristics and rates of compensation when viewed across organizations with the recent volatility of wage rates (McCormick, DeNisi, and Marquardt, 1974). Furthermore, for highly paid positions, it has always been difficult to find a stable relationship between PAQ measured job characteristics and compensation rates.

Combining Jobs into Families. One of the possibilities when one uses numerical job data is that of grouping jobs together based on their similarities. Such groupings have been made, using several different methods (DeNisi and McCormick, 1974; McCormick, et al., 1973) (i.e., BC-TRY, CODAP, and a modified D^2 hierarchical grouping approach). In some cases, jobs from various samples have been relatively homogeneous and in others rather heterogeneous.

Miscellaneous Inquiries. A number of other types of potential inquiries have been suggested. Briefly, these include the derivation of structured interview forms from PAQ data; the use of past job experience (either coded on a form such as the PAQ or listed by D.O.T. number) in assessing qualifications for selection, transfer, and training decisions; the use of PAQ data to develop methods of performance appraisal, possibly in terms of the dollar value of behavior in given areas of the job; and the development of human resource accounting procedures using PAQ and related predictor data as a base (Mecham and McCormick, 1974).

No doubt some of these ideas will prove feasible and others emerge as research continues.

The Use of the PAQ at Present

Some 300 U.S. and foreign organizations have used or are presently using the PAQ for some purpose. This section of the paper will be addressed to the procedures employed in its utilization with examples of the types of results one can expect. First of all, users obtain a Users' Manual, a Technical Manual, and sufficient PAQ's and Record Forms to analyze the desired positions. Instructions for designing the data collection phase or an organizational study are found in the Technical and User's Manuals with specific instructions on analyzing jobs found in a Raters Manual (Marquardt, in preparation). In brief, however, most studies utilize independent sources of information about each job analyzed. A typical arrangement would be to have PAQ's independently completed by an experienced incumbent, a supervisor, and an analyst for a given job, or alternately have PAQ's completed by three analysts. The number of completed PAQ's and the sources of information for a given job depend on the reliability one desires in the data and the perceptual framework from which the job is to be analyzed. For example, one study found that supervisors and incumbents systematically provided ratings which were somewhat different in predictable ways from those provided by trained analysts (Smith, 1975), thus underscoring the importance of using a consistent configuration of data sources.

Once a sampling design has been made and those persons selected and trained to do the analysis, the analyst, incumbent, or supervisor begins to record the degree to which each job element applies to the job being analyzed, using the scales provided. This involves going sequentially through the questionnaire and responding to the elements as they are grouped into six divisions, entitled: (1) Information Input; (2) Mental Processes; (3) Work Output; (4) Relationships with Other Persons; (5) Job Context, and, (6) other Job Characteristics. For supervisors and incumbents, this entails simply reading through the questionnaire and responding on the Record Form. For analysts it means interviewing an incumbent and/or supervisor, preferably near the work place, and rating elements based on observation and questioning.

Following the data gathering, any or all of three different checks for data consistency may be made. The first check, called the "Preprocessing Data Check," involves forwarding the Record Forms to the Data Processing Division with all analyses for given jobs grouped together. The forms are then scanned and differences between forms for the same job are noted. With this information, the user may then seek additional data on elements which lacked similar responses. A second method of checking the data for consistency involves the deriving of factor (or dimension) scores for each Record Form and then comparing all Record Forms for the same job across all factors. This will reveal if differences in the way individual Record Forms were rated are sufficient, when elements are pooled, to be of concern. A third type of check involves computing factor scores for all or a sample of the Record Forms, pairing Forms for each job, and computing inter-rater reliability. This will reveal the reliability of the data generally and determine which factors are most stable. It also will provide reliability estimates for data averaged across various numbers of raters and is used in later analyses to indicate the error associated with various estimates.

Once the user is satisfied that the data are reliable enough for his/her purposes, the data (either from individual or averaged Record Forms) are typically processed to produce factor (dimension) scores showing the relative involvement a job has with different aspects of work in comparison with a varied sample of jobs from the U.S. economy. This type of information may be potentially useful in developing performance appraisal techniques, identifying job characteristics for employment interviewing, assessing training needs, etc. For ease of interpretation, the scores are given both numerically (in Z-score form) and plotted in terms of percentile with the estimated standard error of measurement indicated. Dimension scores are calculated from elements in each individual PAQ division and for elements from the entire PAQ.

From these basic dimension scores, estimates are then made of the expected general ability characteristics of incumbents as a group on the job. For example, the mean scores are estimated for the aptitudes measured by the GATB, along with estimates of the standard deviation of the expected test score distribution, estimated validity coefficients, the likelihood that tests would be found in a final test battery, and a set of estimated cutting scores on the three tests with the greatest likelihood of use in a test battery for the job. Such cutting scores would have typically eliminated about one third of the workforce present on jobs of this type. Such information as this has been useful in test selection and establishing the "job-relatedness" of a given type of test for a particular job. Because of an Employment Service policy prohibiting the release of GATB test scores to employers, the data has thus far been usable only indirectly. It is anticipated, however, that a new battery entitled the Occupational Aptitude and Ability Test Series (OAATS), which has been under development by the author for the last year and a half, will be published and made available to qualified organizations early in

1976. It is hoped that with the accumulation of normative and validity information, the same types of estimates as are presently made for the GATB will be available for direct use by employers with OAATS.

Also included is a general estimate of the compensation level for the job in terms of "Predicted Job Evaluation Points." This type of prediction becomes important in establishing wage and salary policy and in determining internally equitable pay rates for organizational jobs. These data may be ordered for all jobs in the organization to establish a hierarchy of jobs and to identify jobs whose pay rates deviate significantly from jobs with similar characteristics. These predictions may also be modified to reflect the community labor market by collecting area wage and salary data and making appropriate adjustments. Another alternative is to simply develop a regression equation based on present organizational pay rates using PAQ data to predict those rates, and then simply proliferate the policy with new and changing jobs.

Quite aside from predictions generated from dimension scores is the direct use of dimension scores to determine similarities between jobs or to group jobs into families based on those similarities. This is achieved by a modified D^2 hierarchical grouping technique which interatively groups jobs by profile similarity. First it calculates the similarity between each job and every other job, grouping the two jobs together which are most alike. This process of testing for and grouping by similarity continues until all jobs ultimately are placed in a single group. The degree of similarity within the different groups of jobs is indicated by measures of profile match.

This type of information has proven valuable in several contexts, including the combination of similar jobs with separate titles under fewer titles; the use of validity generalization from one job in a family where validity data is available to other similar jobs in the family; and the determination of whether jobs with similar titles are disparate enough to warrant separate titles.

While these are the primary uses which have been made of PAQ data to date, at least one other exploratory use deserves mentioning; that being the use of the JAPQ in conjunction with PAQ data to aid in matching job preferences with job characteristics. At present this is done simply by matching the dimension profile from the JAPQ with the PAQ dimension profile for about 700 different jobs. The jobs most similar are printed first with those less similar printed thereafter ordered in terms of similarity. Also printed are expected GATB score ranges for job incumbents and expected compensation ranges for the jobs listed. Additional work is planned to simplify interpretation and, looking into the future, it may be possible to provide the vocational counselor with estimates of how well a person's aptitudes and interests match a truly large and up-to-date sample of jobs.

By way of summary and in conclusion, the existing theory of matching people and jobs makes it clear that meaningful movement and change naturally occur to lead to a more rather than less compatible relationship between people and their jobs and that the matching process can be enhanced using modern statistical, psychometric, and computer procedures. The PAQ with its attendant processing procedures is a major effort to accomplish this end.

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INFORMATION MAPPING: HOW IT HELPS TASK ANALYSIS

Robert E. Horn
Information Resources, Inc.

DEFINITION

A METHOD which brings together current learning research and instructional technology into a comprehensive design and presentation technology for making communication easier and quicker.

A SYSTEM of principles and procedures for identifying, categorizing and interrelating information required for learning and reference.

AIMS

TO MAKE EASIER AND QUICKER . . .

1. Learning and Reference Work
2. Preparation of Learning/Reference Materials
3. Maintenance of Learning/Reference Materials

PRODUCTS:

- Books for Self-Instruction and Reference
- Data Bases for Computer Assisted Instruction

WHAT IS NOVEL ABOUT INFORMATION MAPPING?

1. Paragraph/frame replaced by
   A. Information Blocks
   B. Information Maps
2. Simple, comprehensive, modular, expandable classification system
3. Can be used for different purposes with minimal changes
4. Ready-to-use, consistent formats for different types of presentation purposes

HOW INFO-MAPPING HELPS TASK ANALYSIS

ASPECTS OF INFO-MAPPING	HELPS IN THESE PHASES . . .	CONCLUSIONS:
Classification System . . .	Helped in structuring large bodies of job/subject matter	— "Natural" — "Easy to work with"
Display Formats . . .	Helped in data gathering phase	— Facilitate acquisition of information
Modularity of Block . . .	Helped facilitate constant change of product/system/job	— Aids modification of documents
Congruity Between Classification System and Display Formats . . .	Helped SME and managerial review	— Intermediate document looked more like final product

INFORMATION BLOCK

DEFINITION

The smallest part of an Information Mapping Analysis. A block consists of

- one or more sentences (or diagrams) about a fragment of subject matter
- a label (which describes the function or contents of the block, such as "definition," "example," etc.)

A Block is always part of an Information Map.

SOME PROPERTIES OF BLOCKS

1. Modular
2. Defined functionally
3. Rules for
   - including/excluding
   - display
   - order
   - number

INFORMATION MAP

DEFINITION

A collection of information blocks (displayed in a particular format) about a limited topic.

ALL SENTENCES AND DIAGRAMS

can be sorted into . . .

BASIC MAPS

- concept
- procedure
- process
- structure
- classification
- fact

SUPPLEMENTARY MAPS

LEARNING

- overview
- compare and contrast

REFERENCE

- indexes
- tables of contents
- summary tables

QUESTIONS

- feedback
- practice
- review
- pretest
- prerequisite
- posttest

FIELDS DRAWN UPON:

1. Educational Technology
2. Learning Research
3. Human Factors Research
4. Display Technology
5. Effective Writing Principles
6. Logical Analyses of Subject Areas

INFORMATION MAPPING USES THESE ASPECTS OF SYSTEMS APPROACH

1. Careful "front end analysis"
2. Rigorous specification of learning objectives
3. Learning hierarchy analysis
4. Criterion-referenced performance tests for initial learning
5. Frequent use of feedback questions
6. Formative and validation testing
7. Algorithms, decision tables, flow charts of all types
8. Branching of all types (where needed)

HIERARCHICAL SYSTEM

COURSES
↓
UNITS
↓
MAPS
↓
BLOCKS

DEVELOPMENT PROCEDURE

1. Front End Analysis
2. List Procedures
3. List Knowledge
4. Write Evaluation Events
5. Identify Maps and Key Blocks
6. Write Key Blocks
7. Sequence
8. Complete and Edit
9. Test and Revise
10. Implement

USES

1. When need to prepare written materials that do not already exist, and . . .
2. When subject/job area is basically . . .
   - Conceptual
   - Procedural
   - Process
   - Classification
   - Structural
   - Decisional

INFO-MAP TAXONOMIES NOT YET DESIGNED FOR

1. Historical Reports
2. Project Planning
3. Argue for/against a Thesis
4. Simulate Events/Transactions
5. Interpersonal Training
6. Psychomotor Training

BUSINESS APPLICATIONS

INFORMATION MAP TYPE	COMPANY APPLICATION
DOCUMENTATION	—computer program documentation —early specification of equipment —project records etc.
REFERENCE	—company procedures books —technical handbooks —sales reference books
INITIAL LEARNING	—technical training materials —operator training materials —maintenance training —functional (sales, finance, etc.) training etc.
ADJUNCT PROGRAMMING	—to guide learning from already extant company materials, including information mapped materials

WHO USES IT?

—Western Airlines	—flight attendants —ticket and freight agents
—Datsun Motors	—mechanics —internal procedures
—Hartford Insurance	—agents —underwriters —managers —clerks —internal memos
—Citibank	—salesmen —clerks
—Public Finance	—management trainees
—Cranfield School of Management (U.K.)	—management training
—Frito-Lay	—task analysis
—Harvard School of Public Health	—physicians
—Royal Naval School (U.K.)	—training technologists

COSTS AND SAVINGS

FOR WRITERS OF INFO-MAPPING

—no more than methods you currently use

—savings of 5 to 20 percent reported

- —less TA time to write
- —less restructuring documents
- —less SME and management review time
- —easier modification of document
- —earlier precision about block contents
- —ease of allocation and management of writing tasks in large projects
- —ease in ability to put material of several writers together

—when single learning-reference document possible, savings in production costs over 2 documents

. . . AND FOR LEARNERS

—up to 30% better retention (according to Western Airlines author)

—decrease in individual training time (because of scanning-aids)

—decrease in reference/relearning time

ADVANTAGES

1. To the learner/user
   A. Flexible
   B. Learning easier
   C. Retrieval easier

2. To the designer/writer
   A. Ease of writing
   B. Ease of managing project
   C. Ease of modifying

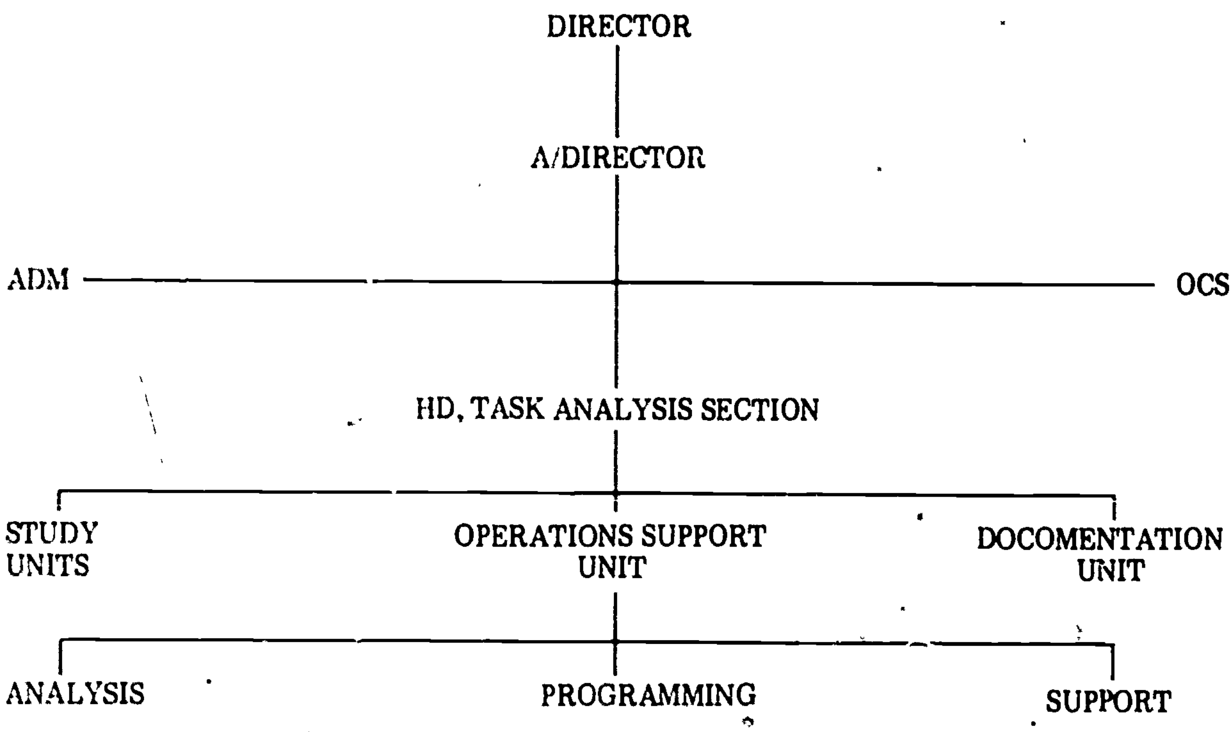
3. To the researcher
   A. Unit of measure
   B. Flexible

THE MARINE CORPS TASK ANALYSIS PROGRAM

Harold L. Angle
Office of Manpower Utilization Headquarters
U.S. Marine Corps

The Marine Corps Task Analysis Program has been fully operational since 1969. At that time the Office of Manpower Utilization was activated as a branch of the Marine Corps Headquarters, in Washington. Since then, we have moved to the Marine Corps Base at Quantico, Virginia, which is about 35 miles south of Washington. We remain an integral part of the Headquarters, however, having dual roles as both branch and field activity under the Manpower Plans and Policy Division of the Manpower Department. We are separated from the Chief of Staff by only two echelons. This places us in a good position not only to perform task analysis but to follow up with the staffing actions needed to effect the organizational changes suggested by the analysis.

It should probably be pointed out that the Director of Training and Education is not in our command chain, but is in a parallel relationship to us. He works for the same DC/S, Manpower that we do. The placement of our program under Manpower Plans and Policy rather than Training has had an effect on the development of our program.



Here is the organization of our office. We have recently reorganized to permit a degree of specialization in the areas of analysis and documentation. Formerly, each task analysis project was assigned to one of several identical project teams. A team was responsible for every aspect of the task analysis process, until the final report had been acted upon by the Chief of Staff. There were three main disadvantages to the project team approach:

• Utilization of the enlisted Marines is each team was on a "feast or famine" basis. They tended to be over- or underworked, depending on which phase a particular project was in at the time.

• Training time necessary to bring each new member up to a satisfactory competency level was too long, because everyone had to learn every phase of task analysis.

• We were putting out a non-standard product. Each team developed a unique style, which was particularly obvious in the documentation produced—for example the Task Inventory Questionnaires and the Task Analysis Reports. A firm effort to achieve uniformity, while retaining the old organizational structure, had been a total failure.

Before we leave this diagram please note the block titled "OCS." This is our Occupational Classification Section, which publishes the Marine Corps Military Occupational Specialties Manual. This book systematizes the entire job structure in the Marine Corps. Its evolution is continuous, with a formal printed change each February and August.

The Marine Corps categorizes each MOS under one of several occupational fields. There are presently 39 such occupational fields for enlisted personnel classification. Each one contains several related MOS's. In the example shown, only 2 representative MOS's in Occupational Field 33 are listed, however there are others. In fact, although there is some variation, the average occupational field contains about 12 or 13 such MOs's. This is an important point to keep in mind, because most of our task analysis will cover an entire occupational field at once.

TASK ANALYSIS PROCESS

1. Construct a task inventory
2. Administer self-report inventory
3. Analyze, using CODAP
4. Recommend solutions to identified problems
5. Secure approval of recommendations

As seen in this list, we go through 5 somewhat overlapping stages in conducting a task analysis. This process actually begins with a meeting between our analysts and appropriate MOS specialists, sponsors and other legitimate interests within the Marine Corps Headquarters. We maintain active contact throughout the process to ensure that the task analysis will be responsive to their particular needs.

We then begin to build a task inventory. Actually the task inventory is the nucleus of a larger questionnaire.

This is basically a self-report, paper and pencil instrument. There are several standard questions relating to duty assignment, experience level, education and so forth. In addition, we ask quite a few questions specific to the occupation under analysis. In many cases these are questions asked on behalf of occupational field sponsors in t' Headquarters. Questions of this nature that do not fit the criteria for task statements, per se, are asked in the first part of the questionnaire

I won't dwell on the task inventory, itself. All U.S. military servies use the CODAP system described by Dr. Christal yesterday. We all construct an instrument laid out much like that pictured here (although I don't believe everyone is currently including job satisfaction measures in their operational task analysis programs).

The main difference may be in the breadth of coverage of our task inventories. Because we must construct a task list that covers an entire occupational field, rather than a single narrow MOS, our task lists are borad in scope and rather lengthy. Because our main objective has been to determine what jobs actually exist within our present occupational fields, we have been willing to put up with the disadvantages inherent in such an approach. However, our task lists, which are all available through the Task Inventory Exchange, may have limited value for such purposes as direct curricula design for a specific technical training course. For curricula design, we would have to turn to the job descriptions produced during the analysis phase.

We administer the instrument, in person, at the Marines' duty stations all over the world. We mail out questionnaires only under the most unusual circumstances, and in those cases we mail directly to an individual Marine—not to a testing center at the Marine's duty station. We consider it of paramount importance that the Marine does not associate the task analysis with a test of his proficiency. We want him to tell us what he really does—not what he thinks he should be doing.

Our analysis process uses Dr. Christal's CODAP. By the CODAP clustering process, we are able to determine what jobs actually exist within the occupational field under study.

Upon completion of the analysis, we write a detailed report to the Chief of Staff, highlighting any problems we encountered in the Occupational Field and recommending specific solutions. These problems ordinarily fall into the areas of structure, classsification, assignment practices or training. We have made a total of 302 such recommendations thus far, and exactly 300 of these have been approved and ordered executed.

Of course this sort of success record implies a lot of staffing with each of the Headquarters agencies whose nonconcurrence could "kill" any recommendation. This is precisely what we do. In the final phase we stop acting like a field office and start acting like the integral part of the Headquarters that we are. This process usually involves three or four staffings, with partial revisions to the report between staffings. Depending on the complexity of the study, this phase can last from six months to well over a year. We spend more time in the last phase shown here, than in the first four phases combined, and this eats up a lot of our available manpower and time.

When the Office was activated in 1969, it was anticipated that it would take about three years to get through every enlisted occupational field. The Office is now six years old, and we haven't yet made it through, for the first time. Part of the reason is that we have had to perform several special task analyses, in addition to the enlisted occupational fields. But the main reason is probably the time consumed in securing approval of our recommendatiolns.

We wouldn't have it any other way. The real payoff in task analysis is not an elegant final report, replete with graphs, tables and a long bibliography. It is in the real-world changes that result in efficiences in manpower utilization.

TASK ANALYSIS PROGRESS

Billets saved	369
One-time material savings	$415,000
ANNUAL training savings:	
Man-years	614
Doilars	$5,370,617

BASED UPON 300 APPROVED RECOMMENDATIONS
IN 25 COMPLETED TASK ANALYSIS PROJECTS

The figures shown here represent our best estimate of what the Marine Corps Task Analysis Program has saved, and is saving, in manpower and training costs. These figures are conservative, and do not reflect inflationary cost increases over the past few years. These are net figures. Some of our recomendations cost money, such as when we determine a need to create a new formal training program. However, on balance, our program has resulted in large savings. Considering that our total operating budget is under $80,000 per year, we have a pretty good cost effectiveness ratio.

Now I would like to walk through one quick example of the way task analysis can affect the structure of an occupational field and the training requirements to support that structure. This is an old study, but it provides an unusually clear example, so we continue to use it for illustrative purposes.

OCCUPATIONAL
FIELD 65

AVIATION ORDNANCE

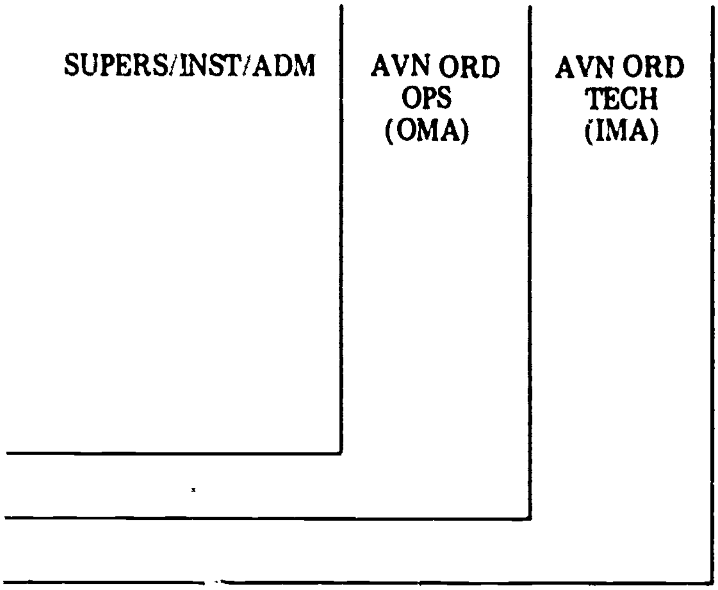
MGYSGT	6511
MSGT	6511
GYSGT	6511
SSGT	6511
SGT	6511
CPL	6511
LCPL	6511
PFC & PVT	6500

MOS	TITLE
6500	Basic Aviation Ordnanceman
6511	Aviation Ordnanceman

When we began the study, the occupational field looked like this. There was a single MOS, above the trainee level, indicating that all jobs in this occupation field were the same, except that the workers were distinguished from the supervisors by military grade. The important point here is that every new member of the aviation ordnance field went through the same training program, which at that time totaled about 23 weeks.

There were about 1700 enlisted Marines in Aviation Ordnance, at the time of the study. We constructed a task inventory based on detailed observation and interview of more than 200 job incumbents. We then administered the self-report inventory to more than half the Marines holding MOS 6511. This represented 88% of all Aviation Ordnance Marines assigned to the commands selected for administration.

JOB/SKILL AREAS
OF 65
AVIATION ORDNANCE



When the CODAP overlap diagram was analyzed, we found something like this. The supervisors, instructors and administrators were easily distinguished from the technical personnel actually performing "hands on" work. No surprise here!

The surprise came in the analysis at the worker level. Rather than confirming that there was one technical jobs, as represented by MOS 6511, the analysis revealed three clearly distinct jobs:

- At the Organizational Maintenance Activity (OMA), there were the ordnancemen who handled munitions at the flying unit. IN effect, these were the Marines whose job it was to arm aircraft for combat missions. They used much—but not all—of the 23 weeks of training.

- At the Intermediate Maintenance Activity (IMA), there were the true technicians. These Marines utilized most of the 23 week training program. However, this specialty accounted for only about 12% of the Marines in the sample.

- The third group, shown over on the right, consists of Aviation Magazinemen. This group accounted for nearly a quarter of the total sample. They are the caretakers of the ammunition magazines. They spend most of their time driving trucks or cutting the grass around the bunkers. In fact, those who perform these functions spend 37% of their time on these two tasks alone. This group was using a little over 2 weeks of the 23 week Aviation Ordnance curriculum.

OCCUPATIONAL FIELD 65

AVIATION ORDNANCE

MGYSGT			6533
MSGT			6533
GYSGT		6531	6541
SSGT		6531	6541
SGT	6521	6531	6541
CPL	6521	6531	6541
LCPL	6521	6531	6541
PVT/PFC		6500	

MOS	TITLE
6500	BASIC AVIATION ORDNANCEMAN
6521	AVIATION ORDNANCE MUNITIONS-TECHNICIAN
6531	AIRCRAFT ORDNANCE TECHNICIAN
6541	AVIATION ORDNANCE/MISSILE TECHNICIAN
6533	AVIATION ORDNANCE CHIEF

As the result of the task analysis, here is what the field looks like today. Rather than a single MOS, there are 3 MOS's. As you can see, MOs 6521, which is the magazineman, terminates at the grade of Sergeant (E-5). If this Marine stays in service beyond Sergeant, he must then be retrained in order to become a 6531. On the other hand, about 74% of these will not stay beyond their initial enlistment. Waiting for a reenlistment before committing the training resources results in a large monetary saving. In fact, restructuring the field so that each specialty receives only the training needed for the specific MOS has resulted in some large cost avoidances.

OCCUPATIONAL FIELD 65

AVIATION ORDNANCEMAN

AVIATION ORDNANCE SCHOOL, CLASS "A"
CURRENTLY PROJECTED FY 72 AND BEYOND

Training Dollar Cost	1,566,547
Training Man-year Cost	226

PROJECTED IAW TASK ANALYSIS RECOMMENDATIONS

Training Dollar Cost	407,302
Training Man-year Cost	58.8

SAVINGS

Training Dollars	1,159,245
Man-years	167.2

These cost figures were based on 1972 training costs. They are undoubtedly higher now. The recommendations that were approved and acted upon in this study cut the occupational field training costs by nearly three quarters. It is admittedly unusual to realize such dramatic savings in a single occupational field, however our net aggregate savings continue to grow, and we are already beyond five-and-a-quarter million dollars per year.

Because my purpose today is to highlight what we consider special about the Marine Corps Task Analysis Program, I will not burden you with details as to what task analysis can and cannot do, nor will I attempt to explain the workings of CODAP. Rather, let us review the main points that make the Marine Corps program what it is:

- The fact that we are actually a branch of the Headquarters makes it possible for us to see our analyses through to actual implementation of our recommendations. We really avoid the bureaucratic delay that could stifle us, were we to pass our completed analyses to someone else for further action.

- Our main goal is manpower utilization. We seek to determine what jobs exist and the relationships between those jobs. Though there are training implications in our studies—and we have had an effect on training—our task inventories do not have a primary purpose of supporting curricula design. This affects the design of our task inventories.

- We develop task lists largely from field observation and interviews. To the list of task statements developed in this manner, we add task statements derived from course curricula, manuals and other documents, as well as input from selected occupational field experts. By this scheme we avoid the circular trap of using present curricula to define the scope of the occupation being trained. Whenever we find any Marine performing a task, we want to include it in the task list so we can determine how many others are also performing that task, We are not trying to answer the question "What <u>should</u> Marines be doing?" The question asked in task analysis is "What <u>are</u> Marines doing?"

- As previously stated, the task list may be aimed simultaneously at several jobs. It is necessary that the list be complete enough so that every Marine can select enough tasks from the list provided to account for 100% of his job. We don't really expect Marines to write in tasks we left out (although we do provide that opportunity).

• The Task Analysis Section is 100% military, and these Marines travel around the world for observation and interview and for actual administration of the instrument We consider the on-site administration to be the key to success in our program. Although we have effected economies elsewhere, we adhere doggedly to this practice.

Not only do we present our own recommendations to the Chief of Staff, but we also author the MOS Manual, in which our recommendations for structure changes are eventually published. This gives us a useful audit check on the entire system and allows us to ensure that nothing gets lost

The Marine Corps Task Anslysis Program is in a continual process of evolution. Although we have nearly completed our initial mission, the task analysis of each enlisted occupational field, there are several new goals that should keep us busy for years to come.

We will reanalyze a few occupational fields that were already task analyzed during the early years of the Program. For the most part, these are occupational fields where technological change, such as the impact of computerization, may call for a second analysis, in light of a new situation

We have already performed a few officer task analyses. These have been largely limited to officer occupations that are technical, or at least relatively well structured. Two of the officer studies were aimed at groups of officer occupations, rather than a single occupational field, with the purpose of determining how much commonality exists among the task performance requirement in the separate occupations.

We now plan to carry combined studies of separate occupational fields over to the enlisted side of the house. The Marine Corps is currently contemplating a revision of the current system of occupational fields in order to improve the homogeneity within each field, for the purpose of enlisted career management. Task analysis will analyze groups of occupations in order to enable decisions regarding revision of the entire structure.

Heretofore we have not had a great impact on curricula validation or design. We have embarked on a campaign to get closer to the educational community so that the educational benefits of task analysis are better recognized. Our first efforts will be in the officer and senior NCO professional training programs at the Marine Corps Development and Education Command. We have just begun an experimental study to test the feasibility of identifying Staff NCO managerial and leadership tasks, by task analysis. This study is in support of the Marine Corps Staff NCO Academy. We hope to perform follow-on studies in support of other Marine Corps professional schools. At this time, there is particular interest in the curriculum of the command and Staff college, a high-level school for Majors and Lieutenant Colonels. At that level, there is a need to develop generalized leadership and managerial skills that have high transferability potential across a wide range of specific duty assignments. We hope to develop the task analytic techniques to identify managerial task performance requirements, in order to help design curricula that will prepare the graduate for success in a variety of high-level assignments. Such curricula can be viewed as transitional in nature, with a goal of facilitating a shift in the mode of a student's thought and behavior to that of a high-level manager. We believe task analysis has a role in this effort.

The basic purpose of a symposium is the exchange of ideas. I have attempted to present this somewhat parochial view of task analysis, as seen through Marine Corps eyes, in the hope that some of the participants may find a useful germ of an idea here or there. All of our task lists are on file with the TIE. In addition, we welcome the opportunity to communicate with others in the task analysis business at any time.

OCCUPATIONAL ANALYSIS IN THE UNITED STATES AIR FORCE

Walter E. Driskill

United States Air Force Occupational Measurement Center

Good morning. I am happy to have this opportunity to present the Air Force's operational occupational analysis program, for it is a program that yields a high return for personnel management. As you will see, there are similarities between our program and the Marine Corps program presented by Lt. Col. Harold Angle. As you may know, similar programs are conducted by the Army and Navy as well.

Before describing the Air Force program, I want to describe the relationship between the Air Force operational program and the research program described yesterday by Dr. Raymond Christal. The operational program is conducted by the Air Training Command, and the results are used in training and other personnel programs. Dr. Christal and his research staff, who are a part of the Air Force Human Resources Laboratory, provide the techniques we employ operationally, and we are most fortunate that his research continues to provide new and improved techniques. Although the Occupational Measurement Center and the Human Resources Laboratory are in different commands, our close relationship facilitates both the operational and research programs. Over the years in the operational program, I have maintained a policy of implementing changes in techniques only after they have been validated through research. I believe such a policy to be fundamental for an occupational analysis program to provide efficient job data.

In this presentation, I describe the operational occupational analysis program that is conducted for the United States Air Force by the Occupational Measurement Center under Air Training Command. Occupational analysis provides us with information that is used both for descriptive and decision-making purposes. Occupational analysis as we define it in the Air Force basically consists of the detailed specification or listing of the tasks that may be performed by job incumbents in a particular occupational field and the determination of the percentages of the incumbents who perform each of these tasks. Job analysis also provides task factor data, such as difficulty, consequences of inadequate performance, and task delay tolerance, which are useful for making training and other decisions. We also collect large amounts of biographical information about job incumbents and information about their work environment, such as the kinds of aircraft they work on and the kinds of equipment they maintain. Also useful to us is information about how Air Force occupational fields are actually structured. Air Force manuals define jobs in each of the occupational fields, but these descriptions are based on what is believed to be done in the fields and how they are believed to be structured. Occupational analysis, through a complex grouping analysis program, provides us with information on how jobs are actually being performed and how they are organized. Frequently we find that our preconception of jobs does not reflect the actual work performed.

Research that led to the present Air Force occupational analysis program began in 1956, and now, 19 years later, occupational analysis has grown into a large and very useful operational program. By 1965, the methodology, including the computer programs for analysis, were ready for operational implementation, but it was not until July of 1967 that the operational program began in Air Training Command. At that time, the program was capable of surveying 12 occupational fields annually, and the staff consisted of 15 professional, technical, and clerical personnel. The following year the program was expanded to a capability of surveying 24 occupational fields annually with a staff of 28 personnel. In 1972, the program was again expanded to a capability of surveying 51 fields annually with a total staff manning of 41. Recently, we obtained additional manning that enables us to survey officer utilization fields and to study management applications of the data. Since the beginning of the program in 1967, surveys of 223 fields have been completed and 73 more are in progress.

The Air Force's occupational analysis process consists of four distinct steps. The first of these is the development of the job inventory or description of tasks that may be performed in an occupational field. The second step consists of the validation of this list of tasks with subject-matter specialists in operational units worldwide. Once the task list is validated, it is then administered to job incumbents through Consolidated Base Personnel Offices worldwide. The final step really consists of two parts, the first consisting of the computer analysis of the data and the second, of the man analysis of what the information means in terms of Air Force classification, assignment, and training.

In the development of a job inventory, our inventory development specialists research reference material pertinent to the occupational field being surveyed. From this research they develop a tentative list of tasks which they use in face-to-face interviews with subject-matter specialists, first at the technical training centers responsible for training in the specialty or occupational field, and second in operational units where subject-matter specialists are actually doing the jobs. Once a point of diminishing returns in interviews is reached, the task list is reproduced and mailed to subject-matter specialists in operational units in the continental United States and overseas for validation.

The comments, changes, and additions from the field validation are incorporated in the final task list. Occasionally we discover that tasks have been omitted, in these cases, we interview personnel to assure coverage. Overall, our experience shows conclusively that it is unnecessary to conduct extensive observation-interviews to describe the tasks in a specialty. Our formal inventories are growing in length. In our early efforts, an inventory for a single ladder averaged 350 tasks. Now, a single ladder inventory averages 600 tasks. The increase results from a more detailed specification of tasks. Initially, for example, we would have written a task as follows. "Align or adjust AVD-2 laser system components." Now we would probably further delineate the task as follows.

Align or adjust AVD-2 cockpit controls
Align or adjust AVD-2 ethylene glycol and water cooling units
Align or adjust AVD-2 transceiver recorders

A job inventory consists of two sections. The first section consists of questions to elicit background and work information about job incumbents. We obtain from a job incumbent such information as his name, grade, social security number, occupational field, and how long he has been in the career field, and his present job. Incumbents names are essential information, first, so that we may determine if respondents are providing accurate information and second, so that we may locate them to gain insight into unique jobs. In addition, we obtain work environment information, such as the kinds of equipment they work on, their satisfaction with the job, and the kinds of aircraft that they work on. The amount of information that can be obtained through the background information section is limitless and is extremely useful for making decisions about the jobs that personnel hold.

The second section of a job inventory consists of a detailed listing of tasks that airmen may perform. In completing this inventory, job incumbents first read through the tasks that are listed, checking the tasks that they perform in their present job. Once they have completed this procedure, they go back and rate each task according to the amount of time they spend on it relative to the others they perform. We have found from experience that the procedure of having the respondent first check the tasks he performs not only provides a frame of reference for the ratings but is less time-consuming in the long run.

The job inventory is administered by Consolidated Base Personnel Offices to personnel whom we specify. We use the Uniform Airman Record file provided by the Military Personnel Center and specify to the base personnel offices the numbers and types of personnel to whom they are to administer the inventory. Our sample is a random stratified sample by skill level, command, and job location. The size of the sample depends upon the size of the career field. In those career fields with 3,000 or less incumbents, we obtain a total sample; that is, we try to administer the inventory to each individual who has been on the job more than 6 weeks. For occupational fields with more than 3,000 incumbents, some percentage of that total number is sampled. The largest survey that we have undertaken, for example, is in the Aircraft Mechanics occupational field which had more than 70,000 job incumbents. In this case, sampling involved about 12 percent of those personnel.

The job inventories are returned to our organization, where we carefully scan and review the returns and prepare the data for computer processing. The data are then input into the Human Resources Laboratory UNIVAC dual 1108 computer where they are analyzed through the Comprehensive Occupational Data Analysis Programs, commonly called CODAP. CODAP is a series of highly complex computer programs that are used to reduce the large amount of data obtained from the job incumbents in the field into a manageable form.

As a result of the CODAP analysis, we obtain three kinds of information. The first consists of biographical and work information about various categories of job incumbents. We are finding useful such information as location of assignment, educational level, equipment utilization, reenlistment potential, and job satisfaction. The second kind of information pertains to the tasks and percentages of incumbents performing these tasks. While CODAP provides a variety of ways of manipulating the data, the important thing to remember is that whatever the manipulation, these kinds of basic information are provided. first, a listing of each of the tasks performed by personnel in the occupational field, second, the percentages of any given group performing each of the tasks; and third, the percentage of time spent by the members who perform the tasks.

The third kind of information resulting from CODAP analysis consists of three types of task factor data, which Dr. Christal discussed in detail in an earlier presentation. For over 3 years, we have collected task difficulty data and now have these data for more than 100 occupational fields. Inter-rater agreement is very high, and we report data only when the agreement exceeds .90. So far, only two sets of ratings have fallen below this criterion. Both sets were from newly created, heterogeneous fields in which incumbent raters had limited experience. Even then both sets exceeded .80. Now we are providing training personnel with data on task delay tolerance and on consequences of inadequate performance. Because of the recency of this development, I have no observations on how successful collection and implementation of the data will be.

The Air Force has put the data to use in a variety of ways. Among the more important are these:

1 career field structuring, in which the organization of occupational fields is validated or restructured;

2. personnel research, where our data are being used by Dr. Christal and his staff to answer research problems;

3. determination of the kinds of maintenance engineering policies that should exist in occupational fields;

4. development tests used to promote airmen in grades E-4 through E-7; and

5. determination of training requirements and instructional system development.

One of the major uses of the data is in the instructional system development model usually called ISD. This model consists of five steps:

1. analyzing systems requirements;
2. defining education or training requirements;
3. developing objectives and tests;
4. planning, developing, and validating instruction; and
5. conducting evaluation of instruction

Occupational data are used in the first step to analyze system requirements, in the second step as a basis for defining education and training requirements, and in the last step to conduct evaluation of instruction. We find for example, that when we have already had an instructional system development project in an occupational field prior to an occupational survey, the survey results are very useful for evaluating the efficiency and effectiveness of the course of instruction that resulted from the ISD application.

A most important use of the data is in determining training requirements. I would be remiss, however, if I were to lead you to believe that we immediately made significant advances in determining training requirements upon the initial use of occupational data. Rather, it was after long and extensive use of the data that we came to know how to make fuller use of results. While, to the vast majority of the people who first use them, occupational data appear to be very useful, when the time comes for them to make use of the data, they simply are unable to make decisions without some criteria that are provided by a policy-making agency. Here, I should emphasize that I feel that any organization that uses occupational data is going to have to define some decision criteria. These decision criteria are fundamental to the effective use of the data.

To show you how we developed the decision criteria, let me illustrate some of the kinds of things that we found in survey results. In a highly complex occupational field dealing with the maintenance, repair, calibration of precision measurement equipment, such as oscilloscopes and scintillation counters, we found that there were some tasks that a majority of the job incumbents performed. In other words, for each 100 people that were trained on these tasks, we found use of the training by 60 percent or more when the course graduates went to their first jobs. We found, on the other hand, many tasks performed by small percentages of the job incumbents. In other words, for every 10 people that were trained on these tasks, we had three or less using their training in their first job. Similar situations occur in all career fields in the Air Force. In fact, there are some occupational fields in which no tasks are performed by a large percentage of personnel, whereas in others there are many tasks that are performed by larger percentages of incumbents.

This finding led us to affirm a policy for training which emphasizes providng initial training on the tasks for which the probability of performance by airmen in their first job assignments is high. On tasks for which the probability of performance is low, other means of training, such as Career Development Courses, on-the-job (OJT), or advanced or supplementary training; should be used to develop proficiency.

Even this policy statement was insufficient to get occupational data used for decision-making purposes, and it was necessary to levy some specific criteria for determining training requirements. Specifically, when a survey of an occupational field is completed, Air Training Command provides the [illegible] center responsible for training. (1) For tasks performed by 50 percent or more of the job incumbents in their first job, training is to be provided so that minimal OJT is required for the course graduate on his first job, (2) for tasks performed by 30 to 49 percent of the job incumbents in their first assignment, background or fundamental training is to be provided. The intent of this training is to make job proficiency training by supervisors easier, (3) for tasks performed by less than 30 percent of the personnel in their first jobs, it is not cost-effective to train everyone in order to train the few who will use their training in their first job. Use of the other task factor data may refine this approach. A number of us believe, however, that for Air Force initial training, the most important factor is probability of performance in the first job. Where probability of performance in the first job is low but tasks are considered "critical" unit training programs are more appropriate for training on the job.

The application of these guidelines has resulted in very significant training cost avoidance. At the Lowry Technical Training Center, for example, the original course for the Precision Measurement Equipment specialty was 43 weeks in length. As a direct result of the application of occupational data the course was reduced to 32 weeks, representing a 25-percent reduction in course length and a dollar "savings" of over $1 million in 1 fiscal year. Other significant course reductions have been made in other specialties. Overall, with the direct application of occupational analysis data in determining training requirements and as a part of instructional system development program, highly significant savings can be shown.

Recently, in one of our management applications studies, we adapted occupational analysis techniques to assess the relevance of training in electronics principles to the Avionics, Communications-Electronics and Missile Maintenance specialties. Normally, we start job analysis with a detailed description of the tasks in a specialty. In our Electronics Principles (EP) project, we started with the EP curriculum materials. Tasks representing the principles were written with the assistance of subject-matter specialists in the various specialties. Validation studies using small samples reveal that test-retest reliability of the EP instrument exceeds .90. Also, the studies tentatively suggest that the relevance of EP taught in our technical courses ranges from very low to moderately high. The instrument seems to differentiate EP requirements among specialties. Large-scale administration in three career ladders will begin in December.

I would like to conclude by pointing out that not all surveys have resulted in the significant savings I have mentioned. I can say categorically, however, that every occupational survey has resulted in some training benefits. For one thing, and this fact is frequently overlooked by training management, we have been able to validate training. It is good to find that the training you are providing is on target. In instances where training appears to be off target, we have frequently been able to correct the situation by reallocating training time within an existing course. Although the total course length may not have been reduced, we have been able to give more emphasis to some areas that need it and to give less emphasis to less essential areas.

In other cases, as I have previously mentioned, we have often been able to reduce training, sometimes by a small amount, a few days, and sometimes by a very large amount, or weeks of training. I am convinced that the use of occupational survey data in any training program can result in a more effective and efficient program regardless of the work environment.

Thank you for your time.

THE INSTRUCTIONAL SYSTEMS MODEL OF THE VOCATIONAL-TECHNICAL EDUCATION CONSORTIUM OF STATES USED TO DEVELOP PERFORMANCE OBJECTIVES, CRITERION-REFERENCED MEASURES AND PERFORMANCE GUIDES FOR LEARNERS

Ben A. Hirst Jr

PHASE II MODEL FOR USE BY THE VOCATIONAL-TECHNICAL EDUCATION CONSORTIUM OF STATES TO MANAGE THE DEVELOPMENT PRODUCTION, DISSEMINATION AND IMPLEMENTATION OF CATALOGS OF PERFORMANCE OBJECTIVES AND CRITERION-REFERENCED MEASURES IN OCCUPATIONAL EDUCATION

INTRODUCTION

The following model is the result of a study of seven other models, those used by the Air Force Training Command, the State of Florida, the State of Michigan, the State of Alabama, Project CAREER within the State of Massachusetts, the Educational Testing Service, and the State of Utah. Components of the model were selected by the application of criteria taken from the Agreement Form of the Vocational-Technical Education Consortium of States (V-TECS), the minutes of the ad hoc Steering Committee which formed the Consortium, and the minutes of the Board of Directors, V-TECS. Some model components were the result of additional research conducted through an exhaustive study of the literature, a computer assisted search of the ERIC files, a computer search of journal articles, and a manual search of the Dissertation International Index.

THE PHASE II MODEL

Activity Number I
Determination of Priorities and Assignment of Catalogs

This activity is the first step for developing catalogs of performance objectives and criterion-referenced measures. The activity has four basic sub-activities which form the rationale and consensus for catalog priority identification and assignment to the member states of V-TECS.

Sub-Activity I-1--State Priority Determination

The member states study data available to them concerning manpower needs, employment opportunities, and student interest surveys to establish a priority list within the state for catalogs of performance objectives and criterion-referenced measures. A state may consider regional and national data to determine its priorities or any other information which it deems necessary or appropriate.

Sub-Activity I-2--Consortium Priority Determination

The Board of Directors of V-TECS will discuss, in turn, the priorities established by each member state. The purpose of this structured discussion is to develop a priority listing from which the member states may select and be assigned a certain number of catalogs to develop. This sub-activity is to assure that duplication does not occur and that a state has the opportunity to negotiate for specific catalogs in which it has a particular interest or for which considerable work has already been accomplished

Sub-Activity I-3—Resolution of Conflict and Exchange of Previous Work Related to Catalogs to be Developed

Should states not be able to resolve priority preference conflicts, a drawing of assignments will be conducted by the Board of Directors. In case a state does not get its desired priority area for reasons identified by the Board of Directors, a copy of such accomplished work would be provided to the state assigned the catalog area in dispute. This material will be included as an essential part of the state-of-the art study to eliminate duplication of effort.

Sub-Activity I-4—Assignment and/or Selection of Catalogs

The Board of Directors makes the decisions concerning the final selection and/or assignment of catalogs after state and Consortium priorities have been determined. Two primary considerations are given member states on the selection of a catlog:

(1) the state has a particular interest in a domain area
(2) the state has accomplished or has in progress considerable work in a domain area which would benefit the Consortium

Catalogs assigned by the Board of Directors of the Consortium are subject to acceptance by the state involved in the assignment.

Activity Number II
The Memorandum of Agreement

A memorandum of Agreement is entered between the state selecting or being assigned a catalog to develop and the Consortium. The parties of the Memorandum of Agreement are the Chairman of the Board of Directors of V-TECS, the Executive Director of V-TECS, and the person designated by the State's Plan for Vocational Education as the State Director of Vocational Education. This activity has three sub-activities which must be completed prior to the developmental work on a catalog and they are as follows:

Sub-Activity II-1—Minimum Contents of the Memorandum of Agreement

The Memorandum of Agreement will be developed by the Consortium staff, and after a period of time, will be standardized. The Memorandum of agreement will contain the following minimum items

(1) date and name of catalog domain area including job titles to be surveyed
(2) designated signature blanks
(3) specific delivery dates for:
    (a) domain study and task lists
    (b) task analysis and survey results
    (c) catalog of performance objectives and criterion-referenced measures
    (d) field test period
    (e) final catalog and field test results
(4) responsibilities of a full-time technical coordinator in the state and to the Consortium
(5) Consortium staff involvement in the development of catalogs and the development of in-service training and dissemination plans

Sub-Activity II-2—Processing the Memorandum of Agreement

The Memorandum of Agreement will take the following course for development and approval:

(1) format developed and prepared by the Consortium staff
(2) Memorandum of Agreement reviewed and signed by the Chairman of the Board of Directors and the Executive Director of V-TECS
(3) Memorandum of Agreement mailed to the states for review and signature by the State Director of Vocational-Technical Education
(4) designated copies distributed and project starts
(5) periodic PERT reports are mailed to states on request

Sub-Activity II-3—Selection of a Project Director

Each state developing a catalog of performance objectives and criterion-referenced measures will select a person to serve as project director. The project director selects and manages writing teams which are composed of selected instructors in the domain being developed. These writing teams are trained by the project director and state technical coordinator to analyze the data resulting from the occupational analysis system, the findings of the state-of-the-art study, and other pertinent information. The project director is responsible for submitting to the state technical coordinator results of studies and analyses of data, catalogs of performance objectives and criterion-referenced measure, and other products required by the Memorandum of Agreement. The project director will meet the same qualifications established by the Board of Directors of V-TECS for the technical coordinator in each state.

Activity Number III
Technical Preparation of V-TECS Staff and State Coordinators

The technical preparation and training of the Consortium staff and the technical coordinators in the states are paramount to maintaining quality control. A program of technical development will begin with an orientation to the model to insure that technical skills and knowledge are sufficiently developed to provide maximum quality control. This activity is divided into six sub-activities which form the basis for staff preparation and training and are as follows:

Sub-Activity III-1—System Orientation

A program designed to insure the performance of Consortium staff and technical coordinators will be administered. The orientation is in performance terms with each person satisfactorily completing the required tasks at a criterion-based performance level. Orientation to the system will not be considered complete until the performance standards are met by the Consortium staff and the technical coordinators.

Sub-Activity III-2—Determining Decision Criteria

The Board of Directors and the staff of V-TECS will develop the decision criteria to be used in the determination of tasks to be converted to performance objectives for cataloging. The decisions will be based upon cut-off indices of time-spent, difficulty, criticality, and task perishability. Other bases for decision criteria may be developed by the Board of Directors based upon research of the data resulting from the surveys of the incumbent workers and their immediate supervisors.

Sub-Activity III-3—Interpretation of Task Analysis Data

An intensive training plan will guide the preparation of Consortium staff and personnel within the states to effectively utilize the data from the task analysis system. This training will assist personnel in the determination of index measures of tasks which are sufficiently high to use in a catalog. Optimum index rating scores will be developed when experience demonstrates that such a rating is feasible. Any tasks which fall below the desired index rating or combination of indice ratings will be excluded from conversion to performance objectives. Continuous training will be conducted for personnel as the task analysis system develops and the analysis of the research indicates a need for further training.

Sub-Activity III-4—Developing Skills in Writing Performance Objectives

Workshops, seminars, and conferences will focus on the development of skills needed to write performance objectives. Consortium staff and technical coordinators will be expected to demonstrate their ability to take a given set of task statements and data, then develop written performance objectives and criterion-referenced test items.

Sub-Activity III-5—Writing of Criterion-Referenced Test Items

Following the training of the staff and technical coordinators in the skills of writing performance objectives from task analysis data and task statements, intensive efforts will be introduced to develop companion criterion-referenced test item(s) for each performance objective. A task statement will yield one or more performance objectives and a performance objective will yield one or more criterion-referenced test items. Criterion-referenced test writing experts will serve as consultants for training Consortium staff and state technical coordinators. Personnel will either be sent to the source of technical expertise or the experts will be assembled in conference, seminar, or workshop settings.

Sub-Activity III-6—Monitoring and Quality Control of Personnel, Education, and Training

The Consortium staff and state technical coordinators will develop individual plans of technical preparation for themselves under guidelines developed by the Board of Directors of V-TECS. These plans would serve as a guide to insure minimum competence levels of personnel of the Consortium staff and within the states. The Executive Director of the Consortium has the ultimate responsibility for monitoring individual training programs of the Consortium staff and state technical coordinators in the states. The Board of Directors will receive at least a biennial status report of the technical prepatation activities designed for individual Consortium staff and technical coordinators within the states. Reports of this nature may be requested any time the Board of Directors desires to know the status of the total plan or individual prrogress of personnel.

Activity Number IV
Domain Study for Catalog Development

The domain study consists of thorough and organized research of what has been developed in performance objectives and criterion-referenced measures which might be appropriate and helpful during the development of a catalog. A domain consists of a broad instructional area (such as automotive mechanics) and should include appropriate job titles (e.g., automotive tune-up mechanic, service station mechanic, servcie station attendent, front end and brake mechanic, general automotive mechanic). Activity IV consists of at least four sub-activities:

Sub-Activity IV-1—State-of-the-Art Study

This activity increases the probability that Consortium projects will find material which has already been partially or fully developed by others in a domain area. The state-of-the-art study will include the following research activities as a part of the states' development of catalogs.

(1) a search of the ERIC system for germane information
(2) a search of the journal index of ERIC for germane articles
(3) inquiries to the U.S. Office of Education, National Center for Curriculum Development in Occupational Education
(4) selected inquiries to state departments of education for germane material
(5) inquiries to industry and private training institutions
(6) review of the Dissertation Abstract International Index
(7) inquiry to local education agencies identified as working on germane projects

Sub-Activity IV-2—Task List Development

A comprehensive list of tasks performed by the incumbent worker will be developed as a part of the domain study. The task list will be based upon research completed in the state-of-the-art study (Sub-Activity IV-1) and, in addition, will include the following:

(1) a job structure arranged from the lowest job titles to the highest job title within a domain
(2) a coding sytem developed by the Consortium and identified in the *Dictionary of Occupational Titles* will be applied to the job structure
(3) development of a task list using the following sources for obtaining task statements.
    (a) review and observation of technical procedures used by workers
    (b) identification of existing task lists or statements from technical manuals and germane literature
    (c) interviews with incumbent workers and their immediate supervisors
    (d) use of craft committees and selected committees of instructors to identify incumbent worker tasks
    (e) provision of space for a survey of incumbent workers to add task statements not included on the list

Sub-Activity IV-3 Development of Background Information

This part of the domain study will be used in conjunction with the task list to provide data which may be cross-tabulated and studied with the companion task lists. The background information section will include as a minimum:

(1) information about the incumbent worker and/or supervisor
    (a) name and address of incumbent worker
    (b) date survey completed by incumbent worker
    (c) job title or classification
    (d) years and months of experience in career field
    (e) years and months of experience in present job title or classification
    (f) pre[illegible] ocational-technical training
    (g) private or public school attendance
    (h) highest grade level completed or GED equivalent
(2) information about job satisfaction
(3) information about utilization of talents and prior training

(4) list of equipment and tools used in the jobs of the domain
(5) type of work environment of the incumbent worker
(6) size of business or industry

Sub-Activity IV-4 Reports of the Domain Study

The following reports will be required of the domain study activity:

(1) State-of-the-Art Study—This report includes the methods used to meet the requirements of Sub-Activity IV-1, (1), (2), and (3) of the model.

(2) Background Information and Task List—This report includes a comprehsnive section on background data to be completed by all incumbent workers who are surveyed. Following this section will be a comprehensive task listing which each incumbent worker will be asked to verify in his job classification. He will also be given the opportunity to add any task he is performing which is not included. The background information and task lists will be printed, in booklet form, in a standard format set by the Consortium staff and approved by the Board of Directors.

Activity Number V
Development and Implementation of the
Domain Sampling Technique for the Task Statement Survey

The purpose of this activity is to obtain a sample of incumbent workers by a domain area and collect certain information from those sampled to be used later in a task analysis. Survey booklets of task statements are developed and printed using a standard format for the background and task statement information. The sampling design would be developed by an independent agency. This activity is divided into three sub-activities dealing with the sample design, sample administration, and processing of the survey results. Alternative procedures are included as a part of Sub-Activity V-1 and Sub-Activity V-2.

Sub-Activity V-1—Design of the Sample

(1) Optimum sample design—The optimum sample design consists of administration of the task statement survey to stratified random sampling of incumbent workers holding a job classified within the domain. The base data to be used in determining the sample size will be the occupational information (coded from the *Dictionary of Occupational Titles*) collected during the 1970 Census of the United States. The body of the information collected will be statistically analyzed with inferences made to the population. (All workers in the United States in a given job classification within a specific domain.)

(2) Alternative sample design No. 1—The alternative sample design No. 1 collects information using the same base data as in V-1 (a) but limits the sample to the member states of the Consortium and makes no inferences beyond those states not included in the survey.

(3) Alternative sample design No. 2—The alternative sample design No. 2 collects information using the same base data as in V-1 (a) but limits the sample to the state which is developing a task survey in a particular domain. A purposive sample could be used by any state desiring to validate task lists within a state not included in the survey.

Sub-Activity V-2 Administration of the Occupational Analysis Survey

(1) Optimum administration. The optimum administration of the survey would be conducted through a central staff in the Consortium office. This would permit control of the follow-up letters, follow-up telephone calls, and general sequence timing of the surveys. Limitations exist in the application of the optimum administration which are proportionate to the activities selected in Sub-Activity V-1.

(2) Alternate administration. An alternative method of administration would be to have each state which develops the task statement list also conduct the survey of incumbent workers based upon the selection of the sample design in Sub-Activity V-1. This method is based upon a thorough development of a sampling administration criteria which will be used in the survey efforts. A sub-sample will be selected and individually interviewed on the work site to compare with the results of the mail-out survey.

Sub-Activity V-3 Processing the Survey Results

The results of the survey will be keypunched or optically scanned and computerized. Various analyses will be made of the data to make decisions about tasks performed by incumbent workers. These survey results will provide the basis for writing performance objectives and criterion-referenced test items. Indices of time spent, difficulty, criticality, and perishability will provide the basis for stratigic decision making. The analysis will be accomplished by using computer programs designed by the U.S. Air Force for this purpose.

Activity Number VI
Occupational Analysis System

The backbone of the Phase II Model is the system used to develop scientific task analysis information based upon a direct survey of incumbent workers. This effort should affect the quality, realism, and scope of the catalogs of performance objectives. The basic source document for the task analysis system is the task statement survey and background information collected from the incumbent worker. Activity Number VI has five basic sub-activities which make up the system of task analysis. These sub-activities have to do with computed indices of task time-spent, task difficulty, task criticality, task perishability, and computer analysis and reporting.

Sub-Activity VI-1 - Task Time-Spent Index

The incumbent workers complete the background information and check the tasks they actually perform in the task statement booklet. After checking the task statement, the incumbent worker rates the relative amount of time spent on the task along a seven-point scale. The response on the scale is converted to a time-spent index based on percentages over the total group of task statements checked. The resulting percentage figure is cumulative to 100 percent on all tasks checked. This conversion of information and calculations is accomplished by use of a computer.

Sub-Activity VI-2 Task Criticality Index

The incumbent worker rates a task in terms of its critical performance. The primary interest of this part of the task analysis is to ascertain by use of a seven-point scale the relative critical values of each task. When obtained, the index of criticality can be applied to the development of performance objectives. A thorough review of this critical index will identify the tasks which are most critical in descending order to those which are considered least critical. On the basis of these data, determination can be made regarding the consequences of a poor performance of the critical tasks.

Sub-Activity VI-2—Task Criticality Index

The incumbent worker rates a task in terms of its critical performance. The primary interest of this part of the task analysis is to ascertain by use of a seven-point scale the relative critical values of each task. When obtained, the index of criticality can be applied to the development of performance objectives. A thorough review of this critical index will identify the tasks which are most critical in descending order to those which are considered least critical. On the basis of these data, determination can be made regarding the consequences of a poor performance of the critical tasks.

Sub-Activity VI-3—Task Difficulty Index

The same process is used to calculate an index of task difficulty which is used in the determination of the time-spent index. A seven-point scale is again employed to determine the incumbent worker's perception of task difficulty. One additional step is included to determine the task difficulty index. The task statement survey is also administered to the immediate supervisor of the incumbent worker. The respones are then correlated, and the resulting figure becomes the difficulty index.

Sub-Activity VI-4—Task Perishability Index

The same sampling technique and incumbent workers are used to obtain a perishability index. This index is a measure, on a seven-point scale, of the relative perishability of a task statement currently being performed by the incumbent workers participating in the survey. This index will relate to the need for retraining or refresher courses should the worker not perform on a continuous basis, those tasks which are rated to have high indices of perishability. One implication of this type of index is to provide guidance for development of self-paced instructional packages which have as a basis the tasks which have the higher perishability indices. Retraining and development of materials could be minimized by including objectives for tasks which have high indices of perishability.

Sub-Activity VI-5 - Processing of Data and Development of Reports

The information collected from Sub-Activity VI-1, VI-2, VI-3, and VI-4 will be computerized for statistical analysis. Information will be translated from qualitative data to quantitative data. The quantitative data will produce the index values of time spent, criticality, difficulty, and perishability. Many other statistical analyses can be applied to the data for the purpose of rank ordering, multiple regression analyses, cross tabulation of tasks with elements and sub-elements of the background information, etc. The resulting printouts will be furnished to the state developing the catalog of performance objectives and criterion-referenced measures as a basis for their developmental activities and decision making.

Activity Number VII
Development of Catalogs of Performance Objectives and Criterion-Referenced Measures

The activities prior to Activity VII have emphasized primarily the training and preparation of personnel, the collection and analysis of information, and other preliminary steps necessary to write and catalog performance objectives and criterion-referenced measures. This activity is the application state of the model. Information from incumbent workers is combined with the knowledge of selected instructors, curriculum specialists, criterion-referenced test designers, and educational researchers to transpose the resulting data into meaningful test items. Activity VII contains four sub-activities designed to accomplish this task which are as follows:

Sub-Activity VII-1 Selection and Preparation of the Writing Teams

(1) Selection of Writing Teams– The project director and technical coordinator screen possible writing team candidates and select those instructional personnel which they determine have the potential and interest to write performance objectives and criterion-referenced measures. The writing team will consist of a minimum of one instructor, one technical writer, one person h ving demonstrated ability and experience in developing criterion-referenced measures and one person having either local or state supervisory responsibility over the domain being developed. Each writing team should have a preferred alternate member who has responsibility in curriculum development at the local or state level. Exceptions to the writing team composition will be made upon requst by the state developing the catalog. The request will be transmitted to the Board of Directors with appropriate justification for the exceptions. Decisions will rest with the Board of Directors.

(2) Preparation of Writing Teams—The state technical coordinator will have the primary responsibility of assisting the project director in the training of the writing team members. The total design of the model will be explained—the results of the state-of-the-art study, the task analysis system, and the conversion process from task statements to performance objectives. Companion criterion-referenced measures will be prepared for each performance objective incorporating performance standards which are used on the job when these standards are available. Components of the training program developed for the Consortium and state technical coordinators will be used as the basis for training and preparing the writing teams for their tasks.

Sub-Activity VII-2--Writing Performance Objectives

All performance objectives developed by the writing teams will meet the definitions and quality criteria set forth in the Memorandum of Agreement. The components of the performance objective will contain the following requirements: situation confronting the learner, action required of the learner, object on which learner is to operate, limits of performance, measurability of the action, communicability of the objective, and degree of proficiency required of the learner.

Sub-Activity VII-3-- Preparing Criterion-Referenced Measures

Each performance objective will have one or more companion criterion-referenced test items to be used by instructional personnel. The test items will be studied to insure that a definite relationship exists between the criterion-referenced item and the standard of performance stated in the performance objective. The definition and components of an acceptable criterion-referenced measure are spelled out in the Memorandum of Agreement and will include: congruence with the performance objective, comprehensibility (expressed at a proper reading level for the level of the training program), objectivity of the test item, integrity expressed in terms of sufficient evidence that the learner can perform the corresponding objective, and equivalence within the test items. The criterion-referenced test items will be developed by the writing teams which develop the performance objectives under the technical direction of the person on the team with test item experience, the director of the project, the technical coordinator in the state, and the technical specialist on the Consortium staff. Particular emphasis would be placed upon explicit information concerning criterion of performance on-the-job and conditions under which performance occurs. Standards would be based upon those used by business and industrial workers.

Sub-Activity VII-4—Developing the Catalog of Performance Objectives and Criterion-Referenced Measures

The performance objectives and criterion-referenced measures will be coded by job classification within the domain being developed. This coding system will be developed by the Consortium and applied to all products of the Consortium. Catalog format and content are outlined in detail and are available through the technical coordinator in each state. All catalogs will be furnished in final draft form (camera ready) for mass production.

Activity Number VIII
Field Testing and Commonality Study

This activity is designed to determine the instructional acceptability of the performance objectives and criterion-referenced measures. The degree of validity will be determined by analysis of teacher and instructor responses to questions during the field test portion of each project. Field test sites and conditions will be selected by the application of a criterion developed by the Board of Directors, Consortium staff, and technical coordinators. Activity VIII consists of four sub-activities as follows:

Sub-Activity VIII-1—Field Testing Design

The field test is designed to control the variables under which the catalogs will be tried by teachers and instructors. Controls are placed upon the selection of the site of field testing, supervisory and administrative support and interest, instructor or teacher interest and ability, type of facilities and equipment, and level of students (junior high schools, secondary, post-secondary, etc.) The primary emphasis is placed upon determining comprehensibility, utility, and appropriateness for instruction as perceived by the teachers and instructors. Constraints which prevent the use of a given performance objective and companion criterion-referenced measures are identified by the instructional personnel.

Sub-Activity VIII-2- Commonality Review

During the field test, several reviews of performance objectives are made by teachers and instructors for the purpose of identifying the common performance objectives across a wide group of occupational education programs. This commonality study identifies those common performance objectives within the catalog which are applicable in several occupational domains. The common core identified is analyzed for implications for curriculum design in general shop, pre-vocational, and comprehensive career education programs.

Sub-Activity VIII-3—Evaluation of Criterion-Referenced Test Items

A jury including an incumbent worker, a criterion-referenced test item writer, an instructor in the catalog domain area, and a supervisor of the incumbent workers represented would be used to make a final review of the criterion-referenced test items. The primary purpose of this activity will be to reach congruence on the behavior being tested and to permit inference of competence should the learner meet the specified performance.

Sub-Activity VIII-4- Determination of Performance Objectives and Criterion-Referenced Measures Which are Applicable to Handicapped Persons

The field test version of the catalog of performance objectives and criterion-referenced test items will be reviewed by a committee of persons to determine their applicability to the training of handicapped persons. The appropriate performance objectives and criterion-referenced test item will be coded for each of the specific types of handicapped persons, i.e., partially sighted, speech defects, hard of hearing, crippled, and mentally retarded, etc. A special review committee for the handicapped will consist of a curriculum developer, an instructor from the catalog domain area and a representative of each of the handicapped groups who has the ability to determine the training limitations of handicapped persons in each group. The work of the committee will be coded and computerized for retrieval for use in planning realistic training programs for the handicapped.

Activity Number IX
Computerize Performance Objectives and Criterion-Referenced Measures

The primary purpose of this activity is to provide immediate response to the states' requests for catalogs. The computer banking of performance objectives and criterion-referenced measures eliminates the time-consuming and costly step of technical editing each time a catalog is revised and updated. Since only those objectives actually changed will be accessed from the computer, the majority remain unchanged and may be retrieved and printed in the same manner each time. Research capabilities, as well as many management possibilities, exist when the computer is used to do time-consuming calculations, compiling, and cataloging of performance objectives and criterion-referenced measures. This activity contains four sub-activities as follows:

Sub-Activity IX-1—Developing Computer Bank of Performance Objectives and Criterion-Referenced Measures

After field testing, the catalogs of performance objectives and criterion-referenced measures are processed and placed in a computer bank for rapid retrieval. The coding system adopted by the Consortium is the key to the retrieval system for the computerized information. The information is arranged so that it may be retrieved by domain area or any coded job within a domain. A member of the Consortium may request the total catalog or any of its sub-parts for use in curriculum design and curriculum building. Information is recorded concerning the perceptions of the teachers and instructors during the field test and commonality review. These perceptions concern the comprehensiveness, utility, and appropriateness of the performance objectives and criterion-referenced measures for instruction. In addition, the perceptions concerning the commonality of performance objectives, across several programs in occupational education, are collected for analysis.

Sub-Activity IX-2—Research Aspects of the Computerized Performance Objectives and Criterion-Referenced Measures

(1) Field Test Data—Information collected during the field test activity is analyzed by the computer. The purpose of this analysis is to identify those performance objectives and criterion-referenced measures which appear to be defective. When the defective objectives and measures have been identified, they are forwarded to the state which developed the catalog with instructions for removing the possible defects.

(2) Commonality Review—The results of the commonality review by teachers and instructors form the basis for the identification of core performance objectives. This common core provides a basis for planning curriculum for pre-vocational, general shop, related subjects, and career education programs. These common performance objectives also provide a framework for prerequisite skills, knowledge, and abilities needed by students to further their preparation for employment at a higher level.

(3) Cross-analysis Research—Computer programs will be utilized which cross-tabulate and cross-analyze data received from teachers and instructors with data collected from the task analysis based upon surveys of incumbent workers and their immediate supervisors. The research implications of these data are unlimited when incorporated into the Revision and Updating Activities of the model.

Sub-Activity IX-3 Management of Performance Objectives and Criterion-Referenced Measures

The application of a code number to each performance objective, which relates it to a specific job classification, provides an added degree of manageability. The performance objectives will be retrieved from the computer bank by job classification, by total domain, by commonality elements, or other mixes required for planning various training programs. The computer can be used to compile the catalog by printing out performance objectives in any desired structure within a domain. Training programs for a new or expanding industry may be designed and retrieved from the computer and can provide those performance objectives which correlate with the job structure of the new industry. The resulting performance objectives provide a realistic planning base for curriculum which must be tailor-made for the task at hand. Many other curriculum management advantages can be developed upon this computer bank of performance objectives. The curriculum design implications are limited only by financial resources and human ingenuity.

Sub-Activity IX-4 Development of Special Reports for Training the Handicapped Learner

The information collected from the work of the special committee for the handicapped (Sub-Activity VIII-4) would be computerized and used as a research base for developing, planning and organizing training programs and activities for the handicapped learner. The performances specified in the objectives and criterion-referenced measures could be modified to permit handicapped workers to demonstrate their ability in terms of particular job titles. Other valuable research could be accomplished by using the data concerning the abilities of the handicapped and comparing it with background information from the incumbent workers and their immediate supervisors.

Activity Number X
In-service Education and Dissemination Plans

Each state using the materials of the Consortium will develop a comprehensive model for disseminating the catalogs of performance objectives and criterion-referenced measures. In addition, a comprehensive in-service training program must be developed which is designed to prepare both instructional personnel and supervisory personnel in the techniques of managing performance-based instruction. Performance-based instruction requires a thorough knowledge and new skills for teachers and their managers if it is to achieve the desired results. This activity contains sub-activities which are directed toward the achievement of an acceptable degree of implementation of performance-based instruction in the classrooms, laboratories, and shops of participating states.

Sub-Activity X-1 In-Service for Curriculum Developers

Specific programs will be planned for preparing curriculum developers concerning the use of catalogs for organizinag learning activities. These programs are to be planned jointly with Consortium staff and include a comprehensive explanation of the system used to develop catalogs, the skills required for retrieving appropriate performance objectives and criterion-referenced measures, and the management strategies necessary to implement a performance-based curriculum effort in the classroom and laboratory. Strategies will also be included to provide direction in the organization and preparation of learning activities.

Sub-Activity X-2 In-service Education for Teachers and Supervisors

A requirement of Consortium mebership is the development, by each state, of an in-service education program for teachers and managers of teachers who will begin to use the catalogs of performance objectives and criterion-referenced measures. The in-service program should be designed to instruct personnel on the intention of the catalog, how to select performance objectives and criterion-referenced measures, and how to supplement their selection with curriculum materials and student learning activities. Those who supervise, direct, or administer programs and have direct contact with the teacher who will be using the material should be trained in the management aspects of performance-based instruction. The basic requirements of the in-service education plan are developed and or modified by the Board of Directors of V-TECS.

Sub-Activity X-3—Dissemination of Materials

A dissemination outline to be developed by the Board of Directors of V-TECS should serve as a guide for the states. The specific methods of dissemination are left entirely to the participating states. The Consortium staff will assist the states as needed and will encourage the dissemination plan to be integrated with the in-service education plan when at all possible. This integration should insure proper preparation of the users and managers of the learning process and, at the same time, provide a logical point of dissemination.

Activity Number XI
Revision and Updating of the Catalogs

The rapid rate of change in a technical society mandates a better way of keeping vocational-technical instructional materials up-to-date; but, more importantly, it mandates keeping them relevant to the needs of a modern job structure. This activity is designed to maximize input from instructional personnel, craft advisory committees, and the incumbent worker so that catalogs may be revised on a scientific and as-needed basis. This activity contains four sub-activities which form a cycle for revising and updating the catalogs. The cycle will take approximately three years to complete with a decision to revise and update or not to revise and update at the eighteen-month point in the cycle.

Sub-Activity XI-1—Field Utilization Study

Continuous field study is made regarding the catalogs of performance objectives and criterion-referenced measures. The purposes of the field study are to: (1) detect the defective performance objectives and criterion-referenced measures, (2) identify additional performance objectives which may need to be added to the catalog when it is revised, and (3) obtain a wider participation in the developmental activities, particularly in the area of curriculum materials.

The field utilization study has two major components for achieving the purposes:

(1) Teacher and Curriculum Developer Inputs—During the first year of use, the teachers and curriculum developers will be asked to react to questions concerning readability, comprehensibility, specificity, and appropriateness of performance objectives and criterion-referenced measures. This information is added to the body of data already existing on the performance objective as a result of the commonality study and the field test results.

(2) Craft Advisory Committee Inputs—Early in the second year, the craft advisory committees for the programs using the material review each performance objective and respond to questions concerning (a) the utility of the performance objective, (b) the appropriateness for present job requirements, (c) the extent to which the performance objective is accomplished by entry level employees, relatively experienced employees, and experienced employees, and (d) the relative criticality of the performance objective.

Sub-Activity XI-2—Analysis of Data from Field Utilization Study

The information collected from the field utilization study is computerized, and reports are developed to determine the results. Statistical analysis is applied to the data to accomplish the purposes of the field utilization study. Data are compared with the results of Sub-Activity XI-3, survey of incumbent workers, for the purpose of deciding whether the catalog should be revised and updated or if it is still sufficiently valid for continued use.

Sub-Activity XI-3—Conducting New Task Analysis

The same procedure used in Activity VI, task analysis system, is used at the twenty-fourth month point in the revision and updating cycle. The same task statements are used with the exception that those added by incumbent workers on the initial survey are included for this survey application.

Additional information requested of the incumbent worker is that he add any tasks he is now doing which do not appear on the list and place an asterisk by those task statements which he has begun to perform for the first time during the last twelve months.

Sub-Activity XI-4—Decision Criteria for Revising and Updating Catalogs

The information collected on the new task analysis is computerized and analyzed. The purpose of the analysis is to determine the extent of new tasks identified by incumbent workers which have been accomplished the first time during the immediate past twelve months. A review of the results of the field utilization study (Sub-Activity XI-1) and the survey of incumbent workers forms the basis for the decision regarding the need for revision and updating of the catalogs or portions of the catalogs. If the data suggests a need for revision the catalogs are put through the same process as for their initial development.

Activity Number XII
Third Party Evaluation of the Vocational-Technical Education Consortium of States

Evaluation of the Consortium on a biennial basis is considered desirable by the Board of Directors of V-TECS. A third party evaluator will be selected on a low bid basis from a group of competent and qualified evaluators. This type of assessment has important advantages and will serve as a basis for self-renewal. This activity contains three sub-activities which are as follows.

Sub-Activity XII-1—Selection of the Evaluation Team

The Board of Directors of V-TECS will select a qualified low bidder as a third party evaluator from states or organizations outside the membership to evaluate and make recommendations concerning the total organization and its procedures. This evaluation shall occur within the first two years of the operation and every two years thereafter. The Board of Directors selects and employs the evaluators and sets guidelines for their study. These guidelines will be used as a basis for developing a well-defined and congruent request for proposals.

Sub-Activity XII-2—The Evaluation and Report of Results

The evaluation is conducted by a team selected by the Board of Directors. The chairman of the evaluation team will be selected by the successful bidder and the members of the evaluation team. The results of the evaluation are forwarded to the Chairman of the Board of Directors of V-TECS with a copy transmitted concurrently to the Director of the Southern Association of Colleges and Schools, the Executive Secretary of the Commission on Occupational Education Institutions, and the Executive Director of V-TECS.

Sub-Activity XII-3 Implementation of the Recommendations of the Evaluation

The Board of Directors of V-TECS reviews the evaluation results and directs the implementation of the recommended changes as it deems necessary and expedient. The administering agency files its response to the Board of Directors for consideration prior to implementation of recommendations made by the evaluation team

GLOSSARY OF TERMS

1. Catalog A collection of performance objectives and companion criterion-referenced test items organized by domain area and further broken down by job titles within the domain.

2. Criterion-Referenced Test Exercise – A criterion-referenced test exercise is an exercise based upon a performance objective and is designed to allow the determination of whether or not the learner has accomplished the objective. It possess each of the characteristics specified below:

a.	Congruence	–	The task specified in the item corresponds directly to the performance specified in the objective, including the situation, action, object, and limits.
b.	Comprehensibility		The item-specified task is so stated or portrayed that the learner clearly understands what is expected of him.
c	Objectivity		The exercise (including component items, if any) is stated in such a way that all competent observers (evaluators) can make a clear and equivocal decision as to whether or not the learner has demonstrated an acceptable performance.
d.	Integrity	–	The exercise is structured in such a way that an acceptable response to the exercise constitutes sufficient evidence, in and of itself, that the learner has accomplished the corresponding objective.
e.	Equivalence		If two or more exercises correspond to a single objective, each exercise in the set would be a true alternate, in that a student who passes (or fails) one exercise on a given occasion would be expected to pass (or fail) any other exercise in the set.

3. Domain – A group of job titles which are closely related according to *Vocational Education and Occupations*, U.S. Department of Health, Education, and Welfare and U.S. Department of Labor, U.S. Government Printing Office, 1969.

4. Domain of Interest – The total content covered by a subject or occupation. Domain charts, as they become a part of a task analysis, provide the limits within which the performance objectives and criterion-referenced test exercises are developed.

5. Incumbent Worker – A person who participates in the survey of workers in business and industry, who holds a specific job at that particular time.

6. Instructional System – An integrated combination of resources (students, instructors, materials, equipment, and facilities), techniques, and procedures performing efficiently the functions required to achieve specified learning objectives.

7. Instructional System Development – A deliberate and orderly process for planning and developing instructional programs which insure that personnel are taught the knowledges, skills, and attitudes essential for successful job performance. This process is also known as Instructional System Engineering and Systems Approach to Training.

8. Job – The composite of duties and tasks actually performed by an individual.

9. Job Inventory – A listing of all tasks to be performed.

10. Job Performance Requirement or Standard – The tasks required of the human component of a system, including the associated standard of performance.

11. Occupational Analysis – The process of identifying duties and tasks which comprise workers' responsibilities, including the collection, collation, and analysis of such data.

12. Performance Objective – A performance objective is a statement in precise, measurable terms of a particular behavior to be exhibited by the learner under specified conditions. It possesses each of the elements or characteristics specified below:

   a. Situation – The situation confronting the learner is clearly specified, including the mode in which stimuli are to be presented.

   b. Action – The action required of the learner is unambiguously defined, including the mode in which responses are to be made.

   c. Object – The object on which the learner is to operate (i.e., the object of the action) is clearly stated.

   d. Limits – The particular limits associated with the activity expected of the learner are specified. (Limits may be placed on situation, action and/or object.)

   e. Measurability – The specified action is an observable rather than an inferred response.

   f. Communicability – The objective is so stated that one, and only one, interpretation of the objective is reasonably possible.

   g. Criterion – The degree of proficiency required as evidence of accomplishment by a student of the objective is indicated. (The criterion may be indicated implicitly or explicitly. If implicit, 100 percent accuracy is effectively designated. If explicit, it may be appended parenthetically to the statement of the objective.)

13. Duty – A distinct grouping of tasks which are related to each other by the nature of the work to be performed.

14. Task – A unit of work activity or operation that constitutes a logical and necessary step in the performance of a duty.

15. Task Analysis – The process of analyzing job inventory data so as to determine training requirements.

THE DEVELOPMENT OF JOB TASK INVENTORIES AND THEIR USE IN JOB ANALYSIS RESEARCH

Sidney Gael
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Introduction

Job task inventory questionnaires seemed especially appropriate for analyzing Bell System jobs because the method was specifically developed and has been used successfully to analyze jobs performed by many widely dispersed job incumbents.

In the Bell System, several groups analyze jobs for a variety of reasons, and Western Electric even offers a course on how to study jobs using the job inventory method. Our work differs from most other job analytic work in our company in that our work is research and development oriented and multi-purposed.

We view job task analysis as a potential central component in an ongoing personnel management system, rather than as a method limited to a single objective or application. Our plan is to preserve the data collection instruments, the data, and the analytic procedures so that unanticipated questions about jobs that crop up can be answered, or periodic updates of the data can be managed at a fraction of the original cost.

There are, as we have seen here, many approaches to job task analysis and the documentation of the results. What most methods seem to have in common is a comprehensive list of tasks that comprise the job activities. The differences between the methods appear to be mainly in format and in the kind and amount of auxiliary data—such as task importance, task difficulty, task time, etc.—requested about tasks.

What I will discuss today is our approach to developing job task inventories, and how we have used them in three projects. The first two projects had specific, narrow objectives by comparison to the third project, which, by the way, is still in progress.

Task Inventory Development

Our first step in the process is to compile a basic task list that describes the work activities and will serve as a focal point for the analyses to follow. We develop knowledge and task statements almost exclusively through interviews. Sources of job information, such as job descriptions and training materials, when they are available, are studied to help understand the job and prepare for the interviews.

The step after knowledge and task statements are derived is to develop data collection instruments. We cast knowledge and task statements, as I will show, in a questionnaire that asks respondents questions about each task, such as:

Do you perform this task in your work?
How often?
How important is this task in your work?
How difficult is this task?
How much time do you spend performing this task?
How well do you perform this task?

Naturally, we define our terms and provide instructions on how to use the numerical scales that determine the responses. As you might suspect, we also request that each respondent provide conventional, biographical information so that we can cross tabulate the data in a number of ways. We have not included every one of the above questions in each inventory we have administered. Though we have not yet done it, we have considered preparing different versions of a job inventory questionnaire, and administering them to different subsets of job incumbents so that we can obtain the information desired without overburdening the respondents..

Job Task Inventory Interviews

The purpose of the interviews is to determine what incumbents have to know to accomplish their work and what they actually do. We have used experienced interviewers who are familiarized with the job task inventory method and the expected interview results. The interviewees are usually immediate supervisors with current, detailed job knowledge, though, in some cases, job incumbents have been interviewed.

The interviewees are requested to bring to the interview samples of all the materials dealt with by the job incumbents, for example, forms, sketches, blueprints, references, job practices, etc. The materials serve to generate discussion of things that initiate work, and of what is accomplished. We have also found that work site visits both before and after the initial interview help to understand the work flow and the work environment, and can clarify some interview results.

Essentially, three separate interviews are conducted to arrive at the knowledge and task statements that will be included in the job task inventory. We refer to them as the initial interview, the verification interview, and the follow-up interview.

Initial Interview

The initial interview is used to obtain the bulk of the job information from which the task statements will be extracted. The interview starts by covering some general topics such as how the job relates to other jobs or how the department in which the job is performed relates to other parts of the company. As the interview progresses, it becomes more and more specific, focusing on input and output related activities. Questioning on what is done with inputs and outputs continues until the interviewee is satisfied that all have been covered.

Interviews rarely progress neatly. Interviewees tend to jump around referring to material previously covered in order to elaborate on activities or to add some activities previously forgotten. They also tend to move back and forth between specific details and general kinds of information. It is therefore necessary to take notes during the interview. Written notes are very useful for identifying unclear topics that can be returned to at a later point in the interview, and the notes are helpful in preparing for the verification interview. Further, note taking indicates to the interviewee that attention is being devoted to the material covered.

We have supplemented written notes by tape recording the interviews. The tape recordings allow independent derivations of task inventory statements for comparison purposes, and, of course, the tapes can be replayed as many times as is desired to clarify particular points.

Verification Interview

The verification interview, conducted with a different interviewer, follows the same pattern. The purpose of the verification interview is primarily to check and modify information already obtained and to cover aspects of the work that may have been neglected in the initial interview.

The interviewer should prepare for the verification interview by reviewing notes taken during the initial interview. Tentative statements for the job task inventory may be drafted and tried out in the verification interview, and certainly, any items that are not clear should be covered.

Extracting Task Statements

The same general to specific approach used to conduct the interviews can be used to extract knowledge and task statements from the interview material. General information about interactions with others, coordinations required, etc., can be reviewed first. Then the physical aspects of the job can be studied. Next, attention can turn to the input stimuli that initiate tasks. Once task statements are written concerning the indicators to the employee for what has to be done, job performance aids, such as reference materials, can be considered. Finally, the ways that the input stimuli and the reference materials are manipulated to develop products are considered.

Follow-Up Interview

The follow-up interview is conducted with the same employees who participated in the previous interviews. The interview is aimed at reviewing a draft of the job task inventory questionnaire. The purpose of the job study is explained and the job task inventory method described. The directions and each statement in the inventory questionnaire are reviewed aloud and are rephrased as indicated during the discussion. Interviewees are encouraged to be critical of the knowledge and task statements.

When the directions for completing the inventory and all the statements have been covered in this manner, the interviewees are asked to check the list of statements for duplicates and omissions. We have also tried the draft job task inventory questionnaire out on a few job incumbents as part of the follow-up procedure.

Modifications, such as those below, are the kinds that can be expected.

The draft statement, "Check arithmetic on vouchers," was revised to read "Check arithmetic on vouchers and bills."

The draft statement, "Solve problems when the system is hung up," was revised to read, "Analyze machine stops."

Engineering Project

The fundamental purpose of the job analysis in the first of the three applications of the job task inventory I will discuss was to determine the qualifications required for three entry level engineering jobs.* Once qualifications were clearly established, it would be possible, among other things, to design and validate improved selection procedures.

The Inventories

The job inventory questionnaires that were developed consisted of several sections. In the first section, the job incumbent provided biographical information. In the next section the engineers rated various academic and company training courses in terms of their relevance to the work they performed. Figure 1 contains a sample from one of the questionnaires; the other engineering task inventories included the same section.

Figure 2 contains a sample from the Outside Plant Engineer Questionnaire in which the engineers rated the importance of various kinds of knowledge to their jobs and then identified the sources from which the knowledge was obtained. For each item of knowledge rated as important, the respondents distributed 100 points to indicate to what degree each of eight possible sources contributed to their knowledge of that particular item.

Figure 3 contains a sample from one of the job task inventory questionnaires in which the engineers rated the importance of each task they performed, their ability to perform it, and where they learned to do it. Here too, for each task rated as important, the respondents distributed 100 points among a number of possible sources to indicate where they learned to perform the task.

Only a few of the job task analysis results can be covered here.

Engineering Study Results

Some differences were found among the jobs with respect to the relative amounts of time spent on various work functions or groups of tasks with similar work content. The COE engineers devote about a quarter of their time to "Monitoring" or follow-up activity, but almost no time at all to "Designing," whereas the OSP engineers, by contrast, are light on "Monitoring" and devote about 39 percent of their time to "Designing."

Academic or company courses, from the first part of the Job Inventory Questionnaire, that proved to be the most important were Arithemetic, Basic Electricity, and Basic Electronics. The courses rated least important for the three entry level engineering jobs were Calculus and Statistics.

The way that the incumbents distributed points across the sources of their job knowledge showed that they derived 71% of the knowledge they needed to perform their work on their present job. Similarly, the engineers reported that the source of 80 percent of their job skills was their present job. The results concerning sources of knowledge and skill for the three engineering positions reinforced the philosophy that job qualification standards calling for prior experience or education should be stated in very specific terms which indicate how the experience or education is related to ability to do the job

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*The jobs studied are but a few of the telephone company engineering jobs, some of which are highly specialized, and the information presented herein pertains only to the three jobs studied.

PART I

FORMAL EDUCATION AND TRAINING

ACADEMIC COURSES

____ 1. arithmetic

____ 2. algebra

____ 3. geometry

____ 4. trigonometry

____ 5. statistics and probability theory

____ 6. calculus

____ 7. computer programming fundamentals

____ 8. physics

____ 9. principles of accounting

____ 10. mechanical drawing

11. basic electricity

...entals of elect...

PLANT TRAINING COURSES (Continued)

(Central Office)

____ 22. Switchboards

____ 23. Step-by-Step Switching System

____ 24. Panel Switching System

____ 25. #1 X-Bar

____ 26. 4A Toll Switching System

____ 27. #5 X-Bar

____ 28. X-Bar Tandem Switching System

____ 29. #1 ESS

____ 30. #101 ESS

____ 31. #23 Type Desks

____ 32. Central Office Frame

____ 33. Line Concentrators

Relevance Rating

3 - Taking this course is necessary background to do my job.

2 - Helpful, but a person could do my job without having taken such a course.

1 - Not appropriate to my work.

0 - Not familiar with course content and can't evaluate it.

Figure 1. Academic and company training courses included in each engineering job task inventory.

IMPORTANCE RATING	PART II KNOWLEDGE STATEMENT OUTSIDE PLANT ENGINEER	SOURCE(S) OF YOUR KNOWLEDGE								
		HIGH SCHOOL	TECH SCHOOL	COLLEGE	BELL COURSE	THIS JOB	BSP	PLT. CONSTR. DEPT.	OTHER PREV. JOB	TOTAL POINTS
	MY JOB REQUIRES AN UNDERSTANDING OF:									
	1. What to look for when taking field notes for aerial facilities									100
	2. Construction results plan information to put on construction work prints									100
	3. New design developments in OSP									100
	4. Design principles of multiple plant									100
	5. The usage of range extenders									100
	6. Bell System terminology, including symbols									100
	7. How to communicate effectiv... ...tractors and builders									100
	...mating costs									

Importance Rating

4 - A thorough and detailed knowledge of this is required to do my job.

3 - Some degree of specialized knowledge is required.

2 - Only a general knowledge of functions or interrelations is required.

1 - Some familiarity is probably desirable but not required.

0 - This is not required for my job.

Figure 2. Knowledge statement format extracted from the Outside Plant Engineer Job Task Inventory.

IMPORTANCE RATING	CAPABILITY RATING	PART III TASK STATEMENT PBX ENGINEER	SOURCE(S) OF YOUR CAPABILITY: HIGH SCHOOL	TECH SCHOOL	COLLEGE	BELL COURSE	THIS JOB	BSB	PLT CENT OFFICE	PLT PBX	OTHER PREV JOB
		MY JOB REQUIRES THAT I									
___	___	1. Read wiring diagrams (T Drawings)									
___	___	2. Complete green sheet properly									
___	___	3. Estimate floor area loadings									
___	___	4. Estimate types and amounts of equipment required in a new PBX									
___	___	5. Estimate PBX equipment layouts in terms of future equipment additions									
	___	6. Monitor cutover committee activities to assure cutover [illegible] will be met									
		Verify y[illegible] ments in PB[illegible]									

4 - Absolutely necessary part of my job

3 - Very important part of my job

2 - Desirable, but not critically important that I do this

1 - Slight importance whether I do this or not

0 - Not a part of my job

Importance Rating

Capability Rating

4 - I can do this as well as anyone

3 - Still have something to learn

2 - Am fairly proficient

1 - Below average proficiency on this

0 - Am not equipped to perform this task

Figure 3. Task statement format extracted from the Private Branch Exchange Engineer Job Task Inventory.

The job analysis results led to the development of a selection procedure composed of several pencil and paper tests, such as Arithmetic and Basic Electricity, a specially developed assessment center procedure designed to get at aptitudes and personal qualities, and some special screening requirements, such as drive a standard shift car, travel overnight, etc. The pencil and paper tests and the assessment center procedure were included as predictors in an engineer selection procedure validation study.

Some of the job incumbents were asked to rate their capability to accomplish the tasks in the inventory. As can be seen in Figure 4, a long time on the job seems to be required to achieve a high level of confidence in performing all tasks of the job. The gradualness of the rise in the self-appraisal curve suggests that there is considerable room for acceleration in the development of engineering skills. If job incumbents could be brought to proficiency at the faster rate indicated here by the dashed curve, significant benefits would accrue from the standpoints both of expense and quality of work. The job analysis provides a solid basis for accelerating employee development through preparation of job aids such as engineering handbooks, and improved training both on the job and off.

Another way that the job study results were used was to develop rating forms that included tasks identified as important to each of the three engineering jobs. Supervisors rated engineers on a task by task basis, and the overall ratings served as one criterion in the engineering selection procedure validation study.

Marketing Project

The second project involved four sales jobs. The purpose of the project was to develop a procedure for selecting higher level sales personnel from among lower level sales personnel and to validate the selection procedure. It was therefore important to determine similarities and differences between the jobs, and the job task inventory method was used to study the four jobs.

Skilled job incumbents were interviewed in this case. One inventory consisting of 128 task statements was developed, and task importance, task difficulty, and task time data were requested. District managers were trained to administer the questionnaire, which was completed by 35 Sales Managers (SM), 23 Account Representatives—second level (AR2), 74 Account Representatives—first level (AR1), and 30 Communications Consultants (CC).

Task statements were grouped into broad job dimensions such as Managing, Selling, Technical and Personal, and the auxiliary data were analyzed in terms of the broader job dimensions. Task importance averages when averaged by job dimensions per job are:

	SM	AR2	AR1	CC
Managing	3.20	1.74	1.24	0.82
Selling	0.76	2.83	2.92	2.36
Technical	1.50	2.27	2.51	2.40
Personal	1.71	2.67	2.58	2.45
Miscellaneous	0.70	1.73	1.70	1.61

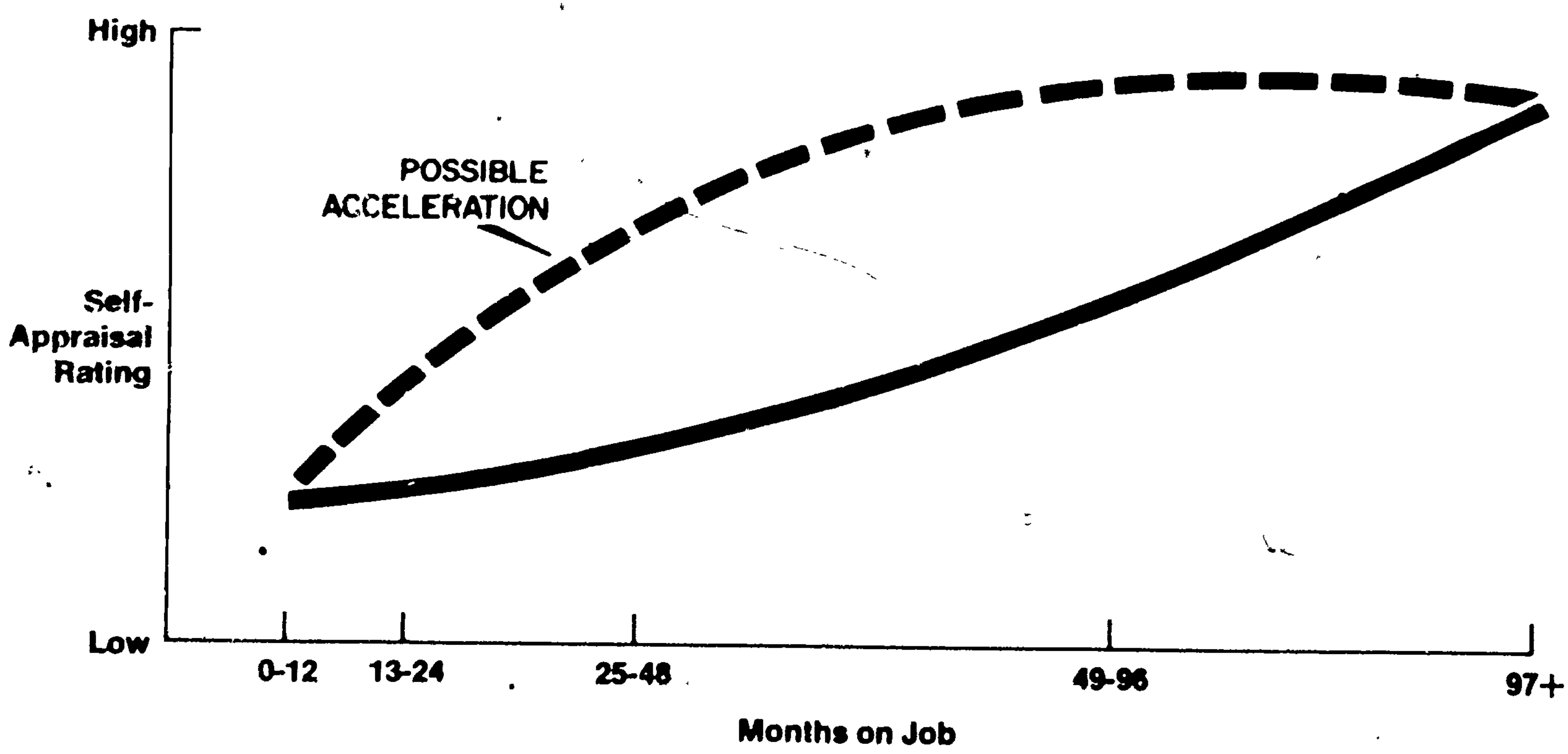

Figure 4. Actual versus hypothesized self-capability ratings.

As might be expected, the Sales Managers regard Managing as much more important than do either of the other three sales jobs. Account Reps and Communications Consultants, on the other hand, regard Selling as more important to their work than do the Sales Managers.

Graphically, as in Figure 5, the differences between the Sales Managers' responses and those for the three other jobs is quite striking. Though the AR2, AR1 and CC jobs are similar in many respects, they are not as much alike as the job dimension averages indicate. A breakdown of the Managing category into functions, as listed below, shows that the differences between the Sales Managers and the other three jobs hold up across the Directing, Controlling, Developing and Forecasting functions, but differences between the AR2, AR1 and CC jobs now show up.

Managing Functions	SM	AR2	AR1	CC
Directing	2.89	1.71	1.02	0.74
Controlling	3.28	1.65	1.39	1.11
Developing	3.27	0.97	0.60	0.35
Forecasting	3.30	2.38	1.77	1.04

An examination of the other dimension functions would reveal essentially the same results, but the Sales Managers would have the low importance averages and the other jobs, the high averages.

If we were to focus on task importance averages per job, instead of, as we have, on job dimension importance averages, it would be clear that a number of tasks are uniquely important to each of the jobs, with the exception of the AR1 job. The job task inventory method proved quite adequate for describing the jobs and identifying similarities and differences between them.

<u>Clerical Project</u>

Turning to the third project, a study of seven clerical jobs in our comptrollers Department, our short range objectives are:

1. To develop a method using job task inventory data for empirically deriving job qualifications, and
2. To assess the feasibility of the job task inventory for broad Bell System use.

In the long run, we plan to assemble the materials, including the computer programs, the documentation on how to use them, and a guidebook on the entire procedure, that will enable other researchers and managers to apply the job task inventory method to jobs in which they are interested.

<u>Approach</u>

Our approach was to develop six different job task inventories to represent the knowledge needed and the activities performed in the seven clerical jobs, one of the inventories covered two jobs. The job task inventory questionnaires were distributed to a field representative at each of three telephone

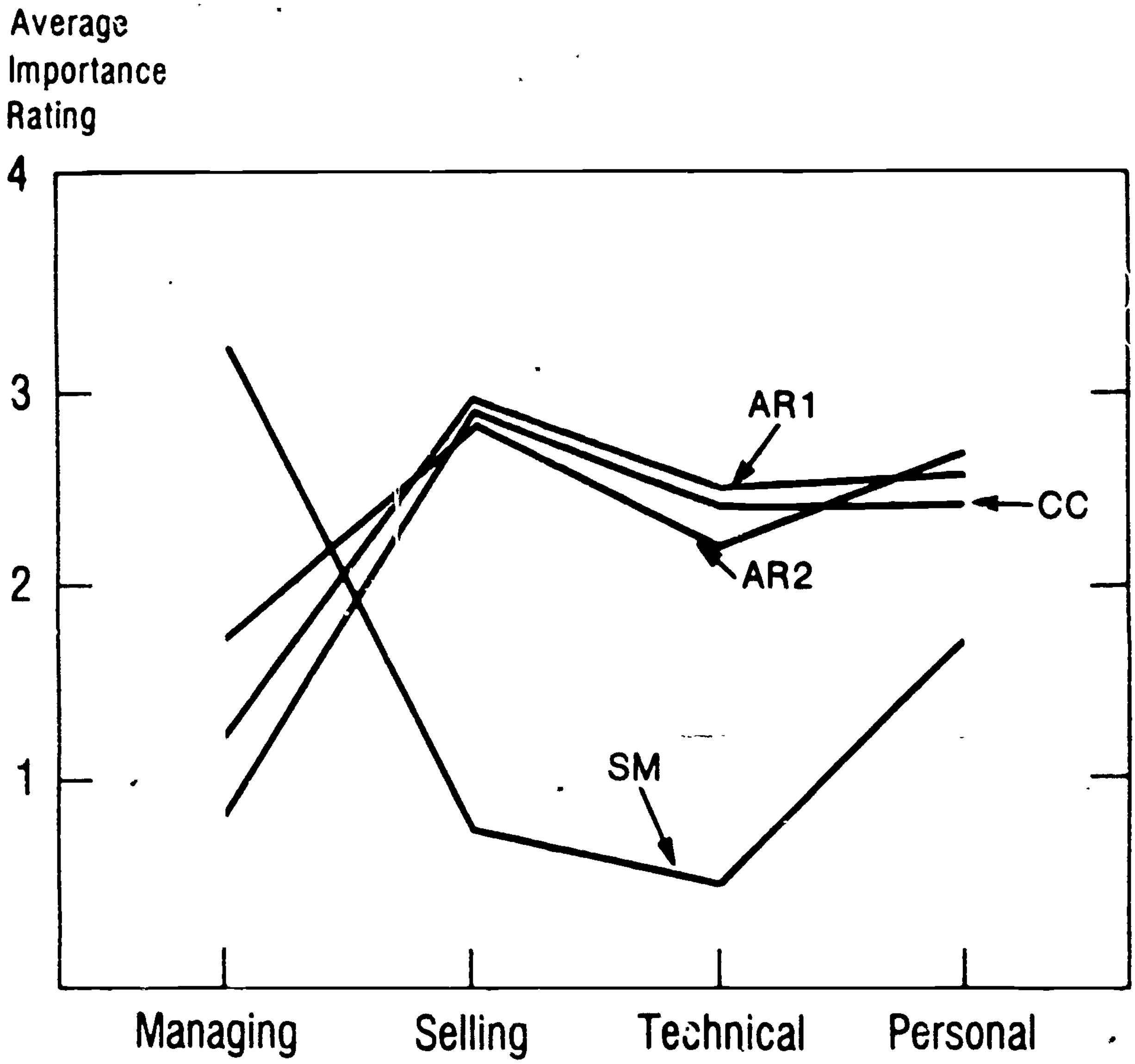

Figure 5. Job dimensions for four sales jobs.

company headquarters, and the field representative, in turn, forwarded the questionnaires, through immediate supervisors, to all job incumbents performing the job of interest in the company. The job inventory questionnaires were completed by about 1,150 clerks working in 26 different cities.

The jobs studied are:

- Console Operator -- multistream
- Console Operator -- single stream
- Keypunch Operator
- Payroll Alottment Clerk
- Revenue Reports Clerk
- Service Order Clerk
- Voucher Audit Clerk

The two console operator jobs were the jobs covered by the same job task inventory, and the other five jobs were covered by individual inventories.

The data collected were analyzed per job by company, by city, and for the total sample. The main thrust of the analyses was to obtain averages for task importance, task difficulty, task time, and the number and percentage of job incumbents performing each task were also tabulated. Task importance, task difficulty, and task time averages were correlated within companies to examine relationships between task dimensions, and between companies to examine relationships between the same dimension.

The relative importance and relative difficulty of a knowledge or task statement was determined by taking both the average and the percentage of non-zero respones into account - a zero response meant that the incumbent did not require the knowledge or perform the task. Statements were classified on the basis of whether their rating was a 3.00 or higher on the average, and were performed by at least 50 percent of the respondents in one, two or three of the companies where the data were obtained. The more important tasks, then, are those that met the 3.00/50 percent criterion in all three companies.

As in the previous studies discussed, functions were formed by grouping tasks containing similar activities or behaviors. Time estimates were computed for each task by multiplying the frequency with which the tasks were performed by the time devoted to performing the task just once. Total time per function and total time for all functions were calculated for each job. By dividing the total time into the time calculated for each function, the percentage of time devoted to each function was determined. A few examples of job functions and the percentage of time devoted to them are as follows.

Payroll Allotment clerks devote about 22% of their time to balancing Accounts, and nine out of 49 tasks were subsumed by this function.

Voucher Audit clerks devote about 57% of their time to Checking and Comparing, and 18 out of 77 tasks were subsumed by this function.

Only a brief summary of what was learned from the job analyses than can be covered here. Generally, task importance averages tended to be on the high side. Task difficulty averages were low to moderate, and the task difficulty averages varied within a very narrow range. High experience levels among the respondents seem to have significantly affected the task difficulty averages and their variation. Time was more evenly spread over many of the tasks for five jobs than for two of the jobs where only a few tasks accounted for the bulk of the time.

Task importance and task difficulty averages and median task time are highly correlated between companies apparently the clerks' responses were consistent. Task importance is essentially uncorrelated with task difficulty, and is correlated to a low degree with task time. Task difficulty is uncorrelated with task time, again probably due to the narrow range of task difficulty averages.

We are now in the process of empirically establishing job qualifications for the seven clerical jobs. Our approach is to present samples of immediate supervisors of each of the seven jobs with a list of skills and abilities and another list of the importance tasks—a 3.00 or better task importance average. After the supervisors are familiarized with the skill and ability definitions and the process we want them to go through, we expect them to assign scale values to each task that represents the degree to which each skill or ability is required to perform each important task. The analysis of the data should yield the job qualifications.

METHODS FOR
CURRICULUM CONTENT DERIVATION

Frank C. Pratzner
Harry L. Ammerman
The Center for Vocational Education

The research and development project on "Methods for Curriculum Content Derivation" is one of many R&D projects at The Center. The focus of the project has been on the development of guidelines and procedures for systematically identifying and selecting content for occupational training programs. Content is one important element of any instructional system and we have delimited our concern to its identification and selection. We are primarily concerned with WHAT content is learned in an occupational program, not with HOW that content is taught or learned. Thus, we are not producing instructional materials nor are we directly attempting to improve instructional methods or techniques though, surely, these are important and worthy areas for research and development.

In a broad sense, the goal of the "Methods for Curriculum Content Derivation" project has been the development and application of new ways to bring the school curriculum and the realities of the work world closer together. We have focused our efforts on those who develop educational programs for work because they decide what job-relevant content to include in the curriculum to enable students to enter and succeed in work. Limited research and the preponderence of existing circumstantial evidence seems to indicate that the content included and emphasized in the curriculum are factors more likely to influence learning achicvement than are the media, methods, or materials for teaching the content.[1] This information, while limited, leads us to agree with the conclusion noted recently by John Flanagan that,

> ...the quality of the present educational programs can be improved more by systematic selection of what is to be taught than by improving how it is taught...
>
> The area of research that has been most seriously neglected in the last decades has been the formulation of educational goals and outcomes.[2]

In vocational education and occupational training, not everything about an occupation can or should be taught. Developers must be able to weed out the merely "nice to know," and unessential content so that learning can be focused instead on the critical job skills and knowledges required by learners for successful occupational performance.

Procedures and guidelines now being developed by our research and development project are intended to enable developers of performance-based curriculums obtain systematic and comprehensive descriptions of what is done by workers from persons closest to and most knowledgeable about job performance. They are intended to enable developers to use these "performance analyses" to identify curriculum content that is timely and relevant to the performance requirements of occupations, and to select from the job-relevant content that content which most warrants some formal training

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[1] Walker, D F & Schaffarzick, J. "Comparing Curricula," *Review of Research*, 44.83-111, Winter, 1974.

[2] Flanagan, J C "Education. How and for What," *American Psychologist*, 28.551-556, July, 1973.

prior to the students' employment. The guidelines and procedures are expected to be of greatest benefit in those situations where there is uncertainty about the performance requirements of an occupation and uncertainty about the content most essential for training.

The procedures and guidelines we are developing will be available to curriculum developers in a set of user manuals. The manuals will contain explicit, detailed descriptions of the procedures and guidelines, along with illustrative materials from several occupations. Five volumes or manuals are planned. Volume I will be an introductory volume. Its purpose is to acquaint the potential user with the overall content derivation process, claifiy terminology, and describe the application of the process. Volume II will describe procedures for stating the tasks of the job and will include guidelines for defining the scope of occupational training interest. Volume III will describe procedures for identifying relevant job performance. Included will be such things as the design of occupational surveys and task inventory questionnaires, and summarizing and reporting survey results. Volume IV will describe procedures for deriving performance requirements for training. It will focus on procedures for selecting tasks which most warrant training consideration. Volume V will be a set of technical appendices for processing survey data. It will include data processing programs, programming instructions, and data identification coding. An annotated list of selected program publications has also been appended.

Those involved in the development of vocational and occupational training programs need effective procedures to aid in the identification and selection of content with known relevance to occupational performance requirements. They need to be able to assure users of their curricula and instructional materials that the things to be learned in the training program are the things most appropriate learned there, and that when they use their materials, students will be learning skills which are important to and required for effective performance in the occupation.

In deciding on what content to include in the curriculum of an occupational training program, those who develop curricula often wish to consider many factors. Some curriculum developers want to consider the stresses or contingencies under which work must be performed on the job. Some are concerned with the generalizability of the skills to be learned and their application in new problem situations. Others look for procedural requirements and performance cues that define mastery of specific tasks. And, still others wish to consider the essential human skills that are necessary for the individual's physical and emotional well-being in the fulfillment of the work. Related conceptual knowledge and comprehension, interpersonal interactions, requisite psychological attributes and physical requirements, and individual feelings and interests of the students are some of the other factors that curriculum developers have said should be considered in deciding on the content of a curriculum.

Regardless of the merit of considering any such factors, to consider any of them in a manner that is comprehensive, systematic, accurate, and specific usually takes considerable time and resources. It would seem helpful and most efficient to be able to narrow the focus upon just those aspects of an occupation that most warrant such expenditure of time and resources. This narrowing of occupational focus is the purpose of the methodologies which are currently being developed by our project.

The intent is to get curriculum developers to the point where they can most efficiently investigate the particular factors in which they have an interest, by whatever process they use to accomplish that examination.

The approach we are developing is an adaptation of the process for conducting occupational task surveys developed over the past 15 years by the U.S. air Force.[3] Our "task inventory method" is a

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[3]Morsh, J. E., & Archer, W. B. *Procedural guide for conducting occupational surveys in the United States Air Research Division* September 1967. (NTIS No. AD-664 036).

Christal, R. E. *The United States Air Force occupational analysis project* (AFHRL--TR 73 75). Brooks Air Force Base, TX Air Force Systems Command, Occupational Research Division, January 1974 survey-questionnaire approach to job analysis being tested for providing performance data of use in deriving relevant and critical curriculum content for occupational training programs. Employing a comprehensive listing of job tasks, knowledgeable persons are asked one or more questions about each task. This information is then summarized in a manner suitable to the particular analyses that may be desired.

The general notion of task listings as the basis for a wide sampling of worker responses is not new, having been the form of a survey of 1,845 workers on 871 activity statements for an occupational area that was reported by Charters and Whitley[4] 50 years ago. One of their purposes at that time, as ours is now, was to determine the job performance requirements for use in defining and justifying curricular content. Renewed interest in this form of occupational surveying was sparked by Rupe[5] as a result of his comparative study of several job analysis methods. With the advent of widely available computer processing for survey data, the survey process became quite feasible and included the capability of new and expanded possibilities for data analysis. This method is used to produce a comprehensive description of what is done by workers in a particular occupation or occupational area. It makes use of an empirical base of timely performance and criticalness data provided by persons close to the current performance of an occupation, usually workers and supervisors, representative of a wide scope of occupational performance situations.

Our Task Inventory method now consists of a number of integrated steps which assist researchers and curriculum developers to move from the definition of the training and occupation of interest, through data collection and analysis, to curriculum content derivation. Elements of the process presently include:

1. Definition of the scope of the occupational training interest (such as the job setting, occupational area, and performance contingencies).
2. Development of a comprehensive list of potential tasks for the job (including review for expression and clarity, as meaningful to working personnel).
3. Selection of questions to be asked about each task to provide desired descriptive data on task relevance and/or criticalness.
4. Pretesting of instructions or new question formats.
5. Design of a sampling plan to obtain representative task data.
6. Preparation, printing, and distribution of the task questionnaires (including background items on respondents, work settings, and organizations).
7. Administration of the questionnaires to workers and supervisors in accordance with the sampling design.
8. Preparation of the questionnaire data for computer processing.
9. Computation of selected descriptive summaries of response data for each task for each job, or for other population subgroups within a job.
10. Preparation of a report of data obtained from the occupational survey, for sharing with others.

[4]Charters, W. W., & Whitley, I. B. *Analysis of secretarial duties and traits.* Baltimore. Williams & Wilkins. 1924.

[5]Rupe, J. C. *Research into basic methods and techniques of Air Force job analysis IV* (AFPTRC TN 56 51). Lackland Air Force Base, TX. Air Force Personnel and Training Research Center. (ARDC), Training Aids Research Laboratory, April 1956. (NTIS No. AD-105 552).

11. Completion of selected analyses of the data, depending on purposes to be served.

12. Preparation of reports to be used for curriculum development and evaluation.

The current program of research seeks to establish additional elements of the process by which task data may be used efficiently in selecting critical performance training requirements, given the determination of what tasks are relevant to an occupation of interest.

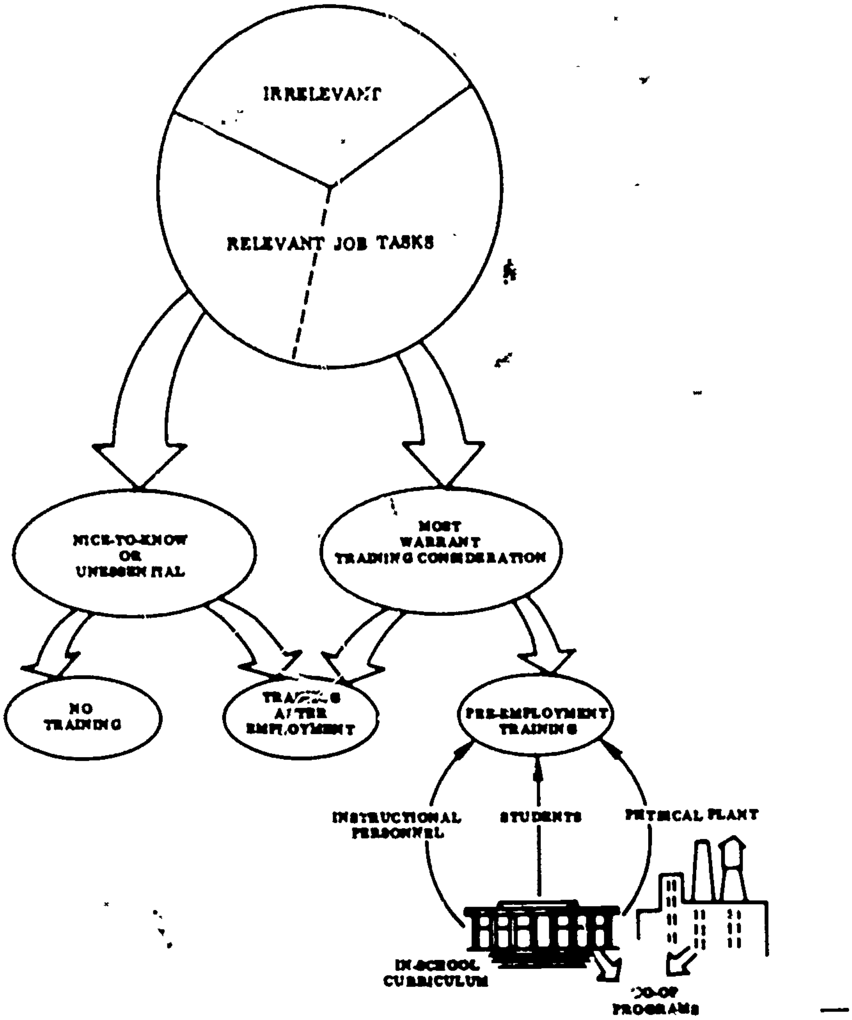
The objective of the program is the development of methods for using timely, first-hand occupational task information to identify critical performance requirements that warrant formal training. In this identification process it is assumed that cost-effective, pre-employment training programs necessarily will not attempt to train students for all tasks performed by experienced workers in an occupation, but rather will assure inclusion of those learning requirements essential for employment and effective job performance. Thus, the identification of those tasks most needing training prior to employment is necessary for planning efficient training programs.

The basic issue of task selection is to identify those tasks having the greatest training criticalness, and eliminating the merely "nice-to-know" and unessential learning requirements The intent is to have procedures to select tasks in a systematic way, using data obtained from persons most closely associated with and knowledgeable about what is in fact required on the job. By such procedures it should become feasible to make curriculum content decisions which are data based and data substantiated, instead of relying solely upon a panel of advisors or the experience of individual instructors.

Task Inventory Questionnaires are able to obtain this data base from a broad representative group of directly-knowledgeable persons. Rules for processing these data are being developed and tested. Subsequently, these rules will be applied to task data to indicate whether each task should be selected or rejected for further training consideration. The selection procedures will provide a systematic way to process a large data base of task information, so it may be used more readily as an information source by those persons who must ultimately make the curriculum content decisions; the rules for selecting tasks will not themselves actually make curriculum decisions. Shortly we will attempt to identify the most efficient set of effective rules and supportive data.

For making curriculum decisions and plans, there is a real need to distinguish between that job content which is relevant to workers in the occupation and that relevant job content which is important for pre-employment training. Comprehensive listings of potential tasks performed by workers in an occupation, in conjunction with data about how many workers do and should perform each task, help establish the relevance of the tasks to that job—at least for purposes of making decisions about training programs. Though some tasks may properly belong to a particular occupation, there would seldom be a concern for pre-employment training on any task unless it would likely be performed by some minimum number of workers. Other information about task performance is also helpful in establishing a task's relevance to the job. Such information as (a) how often a worker typically does the task, (b) how important or significant the task is to the job assignment, and (c) the amount of time spent doing each task are all meaningful indicators of task relevance. These kinds of information have been traditional measures often used to describe the work that is pertinent to an occupation. This job description information is one very important determiner of what is appropriate for training, but certainly not the only necessary ingredient.

From those tasks found to be a reasonable part of the occupation (that is, job relevant to varying degrees), it then becomes meaningful to determine which of these curriculum candidates are worthy of some expenditure of instructional resources and student time. Additional kinds of task information are needed to focus attention on the critical training needs, though some of the relevance data may also be useful for this purpose. Selecting which job-relevant tasks should be of training concern is a more uncertain process than determining their performance characteristics and relevance.



Some relevant tasks may occur quite often, but be of trivial interest for pre-employment training programs. This can occur for several reasons: (a) most students could be expected to be able to do the task before entering training, (b) training could be accomplished equally well or better on the job, (c) extensive job experience may be needed to learn a task, (d) task performance may differ quite radically among employment situations such that no standard learning approach is possible, or (e) only the more experienced workers are expected to perform a particular task, such that early learning of it would not likely be retained until needed. Conversely, the learning need may be immediate and obvious.

And, other relevant tasks may or may not be appropriate for training because of a wide range of other reasons. While full resolution of this issue is not likely, there are some kinds of task information that reasonably can be expected to provide important cues about areas needing training attention. Certainly useful would be knowledge of which tasks are related to on-the-job performance problems and difficulties. To benefit from the experiences and judgment of those persons who are close to the job and aware of the realities of the work situation, it would also appear useful to ask such persons where they feel each task should be learned.

Answers to these sorts of questions have been obtained for the three occupations serving as research vehicles in our R&D project and we are currently attempting to determine which data are most helpful in selecting the job tasks that most warrant training consideration.

Well, in a brief and somewhat sketchy way, that's what we've been up to and about where we are at the moment. In summary let me note several points that I think are important.

1. Our work in this project has been based on the assumption that the most appropriate source of information for the identification of content for performance-based occupational preparation is the job itself and those closest to and most knowledgeable about the performance requirements of the job.

2. There is a growing interest in job analysis and along with this interest a proliferation of task inventories. Task inventories are usually a means to an end, seldom are they ends in themselves.

3. Occupational performance surveys using task inventories can serve a number of useful purposes. When the purpose is to obtain data for making training decisions and curriculum plans, there is a real need to distinguish between that job content which is relevant to workers in the occupations and that relevant job content which is most important for training consideration. Perhaps, in the end, this will be the most important training use of occupational performance surveys.

4. The specific items of information about task performance needed for making training decisions and curriculum plans is not at all clear at the present time. There is a persistent need for further research and development to determine what task information or sub-set of performance data is most useful for selecting content for training.

5. Finally, it should be noted that the process we are attempting to develop to select job content for training can lead to the identification of that relevant job content which most warrants training consideration. That is, it is a process for narrowing the focus to just those performance aspects of an occupation that most warrant some expenditure of instructional time and resources. The final decisions regarding the specific content of training programs and the kind of programs needed will necessarily be made at the local school or local plant setting and will take into account such critical considerations as the availability of instructional personnel, the needs, interests and prior experiences of students; and the physical facilities and available equipment.

ANNOTATED LIST OF SELECTED
PROGRAM PUBLICATIONS

(October 1975)

1. *Automotive Mechanics Occupational Performance Survey. Interim Report*, (R&D Series No. 86) by S. D. Borcher and P. B. Leiter, March 1973.

   This document is intended for use in curriculum development for vocational education programs in automotive mechanics. The results of a task inventory survey of automotive mechanics revealed that on-the-job training and company-sponsored training were the most frequent sources of job skills development. Sample survey materials are appended.

2. *Business Data Processing Occupational Performance Survey. Interim Report*, (R&D Series No. 88) by S. D. Borcher and J. W. Joyner, March, 1973.

   This report presents the results of a task inventory survey for data processing occupations. This interim report provides pertinent occupational data for curriculum developers, instructors, and others involved in planning and conducting vocational and technical programs. Task performance frequencies, task commonalities, and time allotments were determined, job descriptions for data processing were validated, and an occupational career ladder was found to be clearly indicated from the lowest to the highest job titles. Statistical results are appended.

3. *Secretarial Science Occupational Performance Survey. Interim Report*, (R&D Series No. 87) by S. D. Borcher and J. W. Joyner, March, 1973.

   This report contains a revised task inventory that should be useful to practitioners interested in developing curriculum for vocational education in the secretarial science areas. The report validates job descriptions and determines what tasks are common to all surveyed jobs.

4. *Procedures for Constructing and Using Task Inventories*, (R&D Series No. 91) by W. H. Melching and S. D. Borcher, March, 1973.

   This manual is designed to help vocational curriculum experts learn procedures for constructing task inventories and for analyzing occupational performance. Information obtained by task inventory questionnaires can be used to design and revise vocational and career preparation curricula. The reader is guided through an explicit set of steps and procedures for acquiring and effectively using occupational information, and is provided the means by which he can periodically assess his understanding of important concepts and terms introduced in the manual of procedures.

5. *A Methodology to Assess the Content and Structure of Affective and Descriptive Meanings Associated with the Work Environment*, (R&D Series No. 90) by C. C. Liu and D. W. Essex, December, 1974.

   This report describes the activities and results of several exploratory studies of the use of word association procedures to assess the affective and descriptive meanings workers associate with the non-technical aspects of their work environments.

6. *Rating the Job Significance of Technical Concepts. An Application to Three Occupations,* (R&D Series No. 105) by H. L. Ammerman, D. W. Essex, and F. C. Pratzner, December, 1974.

   This report describes a methodology for defining and inventorying the technical concepts that are relevant to an occupation. Technical concepts are the special knowledges and understandings that have practical use to workers in the effective performance of their jobs. The method is described along with descriptive data summarized for three separate occupations: General Secretaries, Automotive Mechanics, and Business Data Programmers.

7. *RCMAT. A Computer Program to Calculate a Measure of Associative Verbal Relatedness,* (Occasional Paper No. 6) by M. A. Mead, June, 1975.

   This document was prepared for general use and as a companion report to the Essex and Liu document described above. It describes the characteristics and usage of a computer program designed by CVE to summarize associative responses given to verbal stimuli by individual and group respondents. The report was prepared to make the computer program transportable and available to other researchers and developers.

8. *Occupational Survey Report on General Secretaries: Task Data from Workers and Supervisors Indicating Job Relevance and Training Criticalness,* (R&D) Series No.) by H. L. Ammerman, F. C. Pratzner, and A. L. Burgin, 1975 (in progress).

   This report presents descriptive task data summarized for a national survey of General Secretaries and their supervisors. Worker performance data, judgements about the criticalness of performance and training, and supervisor expectations were obtained and are summarized for a set of 12 experimental questions for each task of the job.

9. *Occupational Survey Report on Automotive Mechanics. Task Data from Workers and Supervisors Indicating Job Relevance and Training Criticalness,* (R&D Series No.) by H. L. Ammerman and F. C. Pratzner, 1975 (in progress).

   This survey report presents the same kind of descriptive task survey data for the job of Automotive Mechanic as noted above for General Secretary.

10. *Occupational Survey Report on Business Data Programmer. Task Data from Workers and Supervisors Indicating Job Relevance and Training Criticalness,* (R&D Series No.) by H. L. Ammerman and F. C. Pratzner, 1975 (in progress).

    This report parallels the two survey reports noted above (8 and 9) in presenting descriptive task survey data for the job of Business Data Programmer. In combination, 700 employees (workers and supervisors) responded to the three surveys.

TASK SYSTEM ANALYSIS

Wilma Bennett
Hartford Insurance Group

About a year and a half ago the Advancement Center, education and training department of the Hartford Insurance Group, started looking into the benefits of performing more rigorous task analyses. Dr. Sidney Fine gave us a tremendous assist by presenting a workshop on Functional Job Analysis. With the background he provided on the various elements that must be looked at in describing a task, we began developing a method of analysis to meet our own needs.

Looking back, it's relatively easy to say exactly what our needs were. But they weren't always as clear to us as the following list makes them sound. We needed task analyses that would serve two basic purposes and we needed a form for recording these analyses that had certain characteristics.

First, our purposes for performing task analyses:

1. We wanted to use them, as many companies do, as guides for developing training materials and programs.

2. We also wanted to use analyses as guides for preparing tests of task performance that presented circumstances and called for activities as similar as possible to the actual job.

In addition to serving these purposes, we wanted a way of recording tasks that had the following characteristics:

- One form would serve both purposes.

- The form would look uncomplicated and be easy to learn.

- It would let us capture task elements unique to our industry.

- It would be easy to file and retrieve so that we could build up a file of tasks for future reference.

A Systems Approach

The factor that let us meet both purposes while getting the characteristics we wanted was not the way in which we conceptualized the form. Instead the key factor was the way in which we conceptualized tasks. John Gibson, Director of the Advancement Center, feels that a task should be treated as a system, the smallest system that it is worth our while to look at. Thus, the basic assumption upon which all of our task analysis work is built is that a task is a system.

As everyone knows, much work has been done in describing systems. We didn't have to re-invent the wheel here, systems theory is already well defined. Therefore, when we describe a task we do so as we would describe any system, in terms in inputs, actions and outputs.

Looking at an example of a very common task divided into inputs, actions and outputs will help make clear the value the Advancement Center finds in thinking of a task as a system. It will also help illustrate why we use the term "actions" rather than the term "throughputs" in our description.

Inputs

The task "Answer a letter" (Exhibit I) is a good example to use because it is brief and will not get us sidetracked by insurance terminology. An input is defined as "An object or individual which is acted upon in the process of task completion, without which the task cannot be completed." Pen, paper, stamps and envelope are inputs because the task can't be completed without them.

If there is a trigger for the task, something which indicates to the employee that a task must be started, then the trigger is also listed as an input. The task "Answer a letter" is triggered to begin by receiving a letter. "A letter received from another person' is therefore listed as an input.

Task: Answer a letter.

Inputs:

- Paper
- Pen
- Stamp(s)
- Envelope(s)
- A letter received from another person (the "trigger")

Output:

A correctly addressed and stamped letter posted in a mailbox.

Actions:

- Write the letter.*
- Address the envelope.
- Stamp the envelope.
- Insert letter in the envelope.
- Seal the envelope.
- Deposit sealed envelope in a mailbox.

*Throughputs are underlined.

EXHIBIT I

Outputs

After describing the inputs of a task, I prefer to look next at outputs. Knowing the expected output gives me parameters to stay within when I list the actual actions of a task.

In our example the desired output is "A correctly addressed and stamped envelope that has been posted in a mailbox." Whoever undertakes this task cannot assume the task has been completed just because the letter has been written. If the letter hasn't been mailed, this task is unfinished. So, just as inputs often include a trigger telling when a task should begin, outputs include whatever information is available about when the task should end.

Whenever a quality of performance standard can be assigned to a task, that standard is stated in the outputs. If something must be free from errors, then the phrase "free from errors" must appear in the output.

Actions

Actions, obviously, are the various steps a person goes through in performing a task. Action statements always start with a verb, as opposed to input and output statements, which always begin with a noun, adjective or article. If you look closely at the action statements in Exhibit I, the first one for example, you can see that sometimes an object is produced that looks very much like an output. These objects are called throughputs. They are not outputs because producing them does not mean the whole task is completed.

We choose the title "Actions" rather than "Throughputs" because if we list all of the actions of a task then we capture all of the throughputs. But the opposite is not true. Listing all the throughputs will not catch all of the actions of a task.

The Value of Task System Analysis

Earlier it was stated that using inputs, outputs and actions has a specific value for the Advancement Center. The value comes from the fact that insurance is a paper-pushing industry. Frankly, our employees don't always know when they are producing outputs and when they are producing throughputs. In a paper industry it's often hard to tell them apart.

A baker whose cake tasted awful would never think he had done a job well because he had measured and stirred carefully. The difference between throughputs and outputs is very clear in a bakery. But it's not always clear in insurance. When completing form X-375 is done somewhere enroute to completing form Q-982, a person doesn't automatically see that one is a throughput and the other an output. This is especially true when form X-375 takes two hours to fill out and Q-982 takes two minutes.

The Task Statement Form

The form that has been developed to record task information is called a task statement (see Exhibit II). We use the same form for both of the purposes mentioned earlier. developing tests and developing instruction. When the task statement form is used for developing a test, only those blocks that have just been described are completed. inputs, outputs and actions. (Of course, basic identification information is always recorded.) Knowing what an employee starts with, what he must end up with, and the actions he performs along the way gives us enough information to develop an accurate test of performance. (Note on Exhibit II that the actions are much more abbreviated for designing a test than they would be for designing instruction.)

TASK STATEMENT	
POSITION TITLE: Rating technician TASK. Classify, rate, and code Commercial Automobile policies using the new ISO system.	
GOAL	OBJECTIVE
INPUTS • A partially completed Supplemental Rating Application A-3622 (the "trigger") • An ISO Automobile Insurance Manual • A Rating Guide • A calculator	OUTPUTS • An accurately and completely filled out Supplemental Rating Application.
ACTIONS • Refer to the ISO Manual and Rating Guide to locate needed information. • Do necessary computations • Fill in these blocks on form A-3622; —Rating Classification —Business Use —Factor for size Bus. Rad. —Factor (under Spec. Ind. Class) —HCAMRP factor —Final Rating Factor - Bi Liab. Prem. —Medical Payments Premium	 —PD Liab. Prem. —Uninsured Motorist Premium —Rates (after non-Coll. Cov.) —Rates (after Coll. Cov.) —Premium (each covered automobile) —Towing and Labor Costs —Premium —Totals (at bottom of premium column)
COMPETENCIES	
ATTRIBUTES	

EXHIBIT II

Example of a Task Statement for designing a test. Notice that although the actions are abbreviated, the throughputs aren't.

Competencies

However, when the task statement is intended to aid in the design of instruction, then a great deal more information must be collected. We need to know, for example, what knowledges and skills the employee must have in order to perform the actions listed (see Exhibit III). The knowledges a person must have in order to perform a task are not always clear from the actions he goes through to perform that task. For example, the actions in Exhibit III do not tell us that a Classification Code is put together from the Primary Rating Factor, the Special Industry Class Code, and the Major Industry Classification Group. However, the employee needs to know this to complete the code. Therefore, "Parts of a Classification Code" is listed as a required knowledge.

Competencies vs. Attributes

You may have noticed in Exhibit III that knowledges required to perform the task are listed in 2 places, under Competencies and under Attributes. One basic difference between the two is that Competencies are knowledges and skills that can be taught whereas Attributes cannot be taught. An example of an attribute that cannot be taught is a height requirement of 6'8" in order to be a professional basketball player.

Another difference between Competencies and Attributes lies in the fact that Competencies are task-specific and Attributes are not. A Competency can be referenced to more than one task, but it exists only in relation to tasks. An Attribute, on the other hand, can exist without reference to a task.

Attributes

In addition to listing things we can't teach, we find it useful to include in the Attribute block things we don't intend to teach. Rating a Supplemental Application is a complicated task to learn. We're not going to try to teach the person how to multiply decimals at the same time. Being able to multiply is a prerequisite for learning to rate and is listed under Attributes.

Attributes thus include all of the knowledges and skills we don't intend to teach and all of the required knowledges and skills we can't teach. The attribute block is where we include information about interpersonal skills, decision-making skills, language skills, and math skills. We are attempting to develop a series of tests, directed at our own company's needs, to measure these basic attributes. The tests are leveled and the levels will be correlated with job positions.

An Evolving Task Statement Form

As indicated by the fact that we've been working with task analyses for a relatively short time, part of what we are doing is still on a "shake-down cruise." Very possibly, adaptations will continue to be made. The most likely place that will see changes will be the task statement form itself. For example, we may find it necessary to indicate somewhere on the form whether the task is being described for purposes of testing, for purposes of training, or for both. In addition, we have found Robert Horn's Informaion Mapping so useful for training materials, that we may try to use it for our task statements. Finally, we sometimes find we don't have room on one page to say everything that we've got to say. We could change to a longer page, to two pages, or to both sides of the page. Whichever we end up with will be what works best for us.

This point is made to emphasize the fact that we've developed something to fit our needs. We don't anticipate that our solution will fit anyone else's needs exactly. However, if part of our solution is useful to others, we will be more than delighted to share. It will, in a small way, repay the many people who have shared with us at The Hartford and enabled us to develop task analyses that work for us.

TASK STATEMENT

POSITION TITLE: Rating Technician

TASK. Classify, rate, and code Commercial Automobile policies using the new ISO system.

GOAL	OBJECTIVE

INPUTS	OUTPUTS
• A partially completed Supplemental Rating Application A-3622 (the "trigger") • An ISO Automobile Insurance Manual • A Rating Guide • A calculator	• An accurately and completely filled out Supplemental Rating Application

ACTIONS

A. Use the Rating Guide to determine the Primary Rating Factor and Class Code:
   1. Locate this table: Determination of Primary Classification Factor and Code.
   2. In the column marked SIZE, locate the area for L (Trucks).
   3. In the column marked BUS, locate the S category.
   4. In the column marked RADIUS, locate the L category.
   5. Follow a straight line through the above 3 items to find the correct factor and code.

B. Use the Rating Guide to determine the Secondary Rating Factor and Code.
   1. On form A-3622 locate the letter designation for Special Industry Class.
   2. Locate this table on the Rating Guide: Secondary Rating Factor and Code.
   3. Etc.

COMPETENCIES

Knowledge of:
- Primary Rating Factor Classification
- Exposure Types
- Vehicle Size Classes
- Business Use Classes
- Radius Classes
- Special Industry Classes
- Major difference between form A-3622 and form A-3471
- The parts of a Classification Code
- Total specific vehicle rate formula
- Etc.

Ability to:
- Locate Primary Rating Factor and Class Code
- Determine Secondary Rating Factor Category
- Calculate Final Rating Factor
- Determine Liability Base Rate
- Calculate BI Vehicle Rate
- Determine Vehicle Age Group
- Calculate PD Vehicle Rate
- Round off according to Rule 10
- Etc.

ATTRIBUTES

- Ability to add, subtract and multiply decimals

EXHIBIT III

Example of a task statement for designing instruction.

JOB TASK ANALYSES IN TEXT AND TEST DEVELOPMENT
A Method for the Novice Training Instructor

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ABSTRACT

The job task analyses for enlisted ratings in the U.S. Coast Guard provides the basis for designing and writing advancement examinations and non-resident training courses produced by the Coast Guard Institute. A highly structured, closely supervised procedure allows subject matter specialists who have no experience as instructors or test writers to produce job-relevant materials from the job task analysis. This is done with little or no time lost to formal instruction or mis-directed effort. The process produces a spinoff of instructor insights which allows follow-on training to focus on a higher level of sophistication than the same amount of job-entry training for the instructor would allow.

The Supreme Court of the United States has mandated in the case of Griggs vs. Duke Power Company that "tests must measure the person for the job and not the person in the abstract." This decision places a requirement on those who design and administer selection tests to design tests which do, in fact, measure each person for the job he is seeking. One method, a very effective one, for meeting job relevancy criteria is to develop the tests from job task analyses.

The job task analysis describes the many facets of the job and establishes the relative roles of these various facets in job performance. Computer analyses of percent of persons performing the specific tasks, or percent of time spent by all members performing the tasks, or consequences of inability to perform when required, all provide the test designer with a wealth of data. This data can be used to construct tests which are directly related to tasks performed on the job. This method of test construction results in a high expectation that the tests will thoroughly meet the criteria set by the Congress of the United States in the Civil Rights Act of 1964 and interpreted by the Supreme Court in Griggs vs. Duke Power Company. There is a further expectation that the test will also be a more effective selection instrument than tests which may be developed by other methods.

It is easy to describe a test development system which is based on job task analyses. It is quite another thing to actually prepare such tests. Actual preparation requires a close coordination between subject matter specialists and educational technologists to ensure success. Without this coordination the tests will be neither relevant to the job nor predictive of future performance. The subject matter specialist must have an input to ensure the technical accuracy of the test items and the educational technologist must have an input to ensure that the test items provide a relevant sample of factors required for the job. The input of each must complement the input of the other.

The U.S. Coast Guard Institute produces its selection tests for the enlisted advancement system by using this team approcah based on job task analyses. Data from the job task analysis for each enlisted rating (specialty) in the Coast Guard is used as the basis for designing correspondence course training texts, criterion referenced tests to establish successful course completion, and norm referenced tests to rank order candidates for advancement within each rating. Though designed for different purposes, each of these three products is developed from the common ground of the job task analysis. This common development assures efficient training and testing by focusing on job relevant information and precluding that which is irrelevant. It also allows the subject matter specialist, who is not a professional educator, to design text and test materials with minimum supervision and review.

The development process is highly structured so that product review and revision can be narrowly focused. Typical models for instructional systems show a single step from the job task analysis to "Behavioral Objectives," followed by another single step to "Selection of Instructional Method." This single step oversimplication is what leads to many of the valid criticisms of the use of behavioral objectives in curriculum development. Too often the behavioral objective statements focus on trivial and glib statements of desired learning outcomes. The value of the job task analysis is greatly reduced when behavioral objectives are intuitively stated in advance of extensive, detailed manipulation of the job task analysis data. By increasing the number of steps in the process and formalizing the actions to be taken to accomplish each step, meaningful learning outcomes can be described. In the process, the subject matter specialist will produce working documents which he can later rely on for the detailed work of writing texts and tests. The rigid structuring of the early stages of the development process is difficult to sell to new subject matter specialists, but the payoff in the latter stages is so great that they become avid proponents by the end of the process.

Subject Matter Specialists at the Coast Guard Institute are senior technicians brought in from field duty for a single three-year tour of duty as instructors. They are all Chief Petty Officers, Senior Chief Petty Officers, or Master Chief Petty Officers. All have devoted the better part of the past twenty years progressing from job entry level in their ratings through the journeyman level to the supervisory level. Their subject matter knowledge and their perspective on the actual job environment make them particularly valuable in developing job related texts and tests. They are complemented in the process by civilian staff advisors who are either professional writers or educators.

The new instructor (subject matter specialist) is first exposed to a brief indoctrination program. He is shown each of the steps to be followed in the process and is given a brief explanation of each step. The object of this indoctrination is to acquaint him with the requirement to go through a prescribed process, not to make him proficient in the process itself. We want him to be aware from the outset that text and test development must follow definite steps. As he reaches each of the steps in the process, staff members will provide additional training to allow him to proceed to the next stage. This allows maximum efficiency in staff use. Both the subject matter specialist and the staff advisor will focus their efforts on one narrow part of the process at a time. Each will know that the work produced to that point has been reviewed and approved, so there is no need to go over the same ground again. Because approval is required before proceeding to each new step there is assurance for both the writer and the advisor that there is no need to regress to earlier steps to correct defects carried through several steps. Correction occurs from the beginning of the process. Extensive, formalized review eliminates rejection of near completed work, and of course, avoids the frustration which goes along with rejected work.

The starting point is the job task analysis. Our interest for this process is confined to three types of analyses. percentage of people performing the task, percentage of time spent on the task, and grade level of people performing the task. The Enlisted Rating Qualifications Manual provides guidance on which tasks are required for each grade level, and the instructor's experience fills in the gaps that may have been left in preparation of the job task questionnaire. Using the data on numbers performing and time spent on each task, the instructor must first select out those tasks which cannot be taught in a correspondence course. Tasks which require practice, manual dexterity, close supervision, or "feel" are dropped out. This review also eliminates those tasks which should not be taught in a correspondence course. The target here is the list of tasks for which on-the-job training and drills have been prescribed by the Commandant or the District Commanders. This divides the job tasks into two categories. "those to be taught" and "those not to be taught." The rest of the steps apply to the development of correspondence course material based on the list of tasks "to be taught." Those in the "not to be taught" category will go through an identical development process, and will be reunited with the first category tasks later in the process.

Two other decisions must be made during this stage. A cut-off point must be selected to separate those tasks performed often enough to be taught and those performed too seldom to be worth teaching. The second decision also requires identifying those tasks in the "too seldom performed" category which, though seldom performed, are critical on the job. The amount of resultant text material is one of the main criteria for fixing the cut-off point. The services of a staff advisor are available during this phase to assist the instructor in deciding whether text can be developed on a task, and if so, how much text will result. When this step has been completed, the supervisor will review the list of tasks to be taught.

STEP TWO

Using the "paygrade performing" form of the job task analysis and the Enlisted Qualifications Manual (Quals Manual), the instructor will assign each of the tasks to the proper paygrade, E-4 through E-7. The job task analysis will tell him which paygrade is performing the tasks and the Quals Manual will tell him which paygrade must be able to perform it. If the task is required at a lower grade level than that commonly performing it, the task will be taught at the lower level. It may also be taught at a lower level than indicated by either the job task analsysis or Quals Manual if a more efficient progression of rating courses will result. Often we find that many of the things required at the E-6 level on the job can be better taught at the E-5 level. Because enlisted duty assignments in the Coast Guard are not rigidly controlled by paygrade, we are able to make this type decision without discomfort. Instructor experience and judgment are just as important at this stage as the job task analysis and the Quals Manual.

During this stage the instructor must often revise step one, adding or deleting material. Courses for four grade levels will be required. If a grade level becomes flooded with material to be taught, the text will be too cumbersome to be completed by the student. Adjustments are made by shifting some material to a lower level course or by deleting some of the tasks selected in step one. If too little material results for a grade level, additional tasks may be added to the original list. The supervisor will review this stage when it has been completed.

STEP THREE

The supervisor will specify which of the four grade level courses is to be developed first. The instructor then takes his list of tasks for that grade level and begins several steps of organizing and subdividing.

Tasks listed on the job task analysis are in the order dictated by the responses of participants in the job task survey. To be useful in writing text material, the tasks must be regrouped. The tasks are first grouped into broad categories, or topics, based on the similarity of the tasks. Because this is primarily a clerical chore and is very much within the realm of expertise of the instructor, there is no review required before the next stage is begun. When the instructor is satisfied, he moves on to the next stage.

STEP FOUR

This stage is brief, and, again primarily clerical. All of the tasks within each topic are put into a logical order. The instructor has free choice in deciding on the order, arranging the tasks from simple to complex, in the order they are performed, or any other order which he feels is logical for the topic. He proceeds independently to the next stage.

STEP FIVE

Once again the instructor is operating within the realm of his experience and expertise. Each of the tasks is broken down into all of the steps necessary to complete the task. This subdivision continues until the list of steps, or Job Subtasks, cannot be broken down any further. The supervisor reenters the process and reviews the third, fourth and fifth stages.

STEP SIX

For the first time the instructor is going to operate out of the realm of his expertise, though not necessarily out of the realm of his experience. In this sixth stage, he will convert his list of Job Subtasks into a list of Lesson Subtasks. So far he has been dealing only with what is required on the job, where there are boats, engines, tools, typewriters, radars, radios and other similar things. Now he must convert the list of job subtasks to lesson subtasks, because in the lesson the only things the student will have are paper and pencil. Each lesson subtask must be a paper-and-pencil version of a job subtask. Generally, lesson subtasks will be statements of the decisions which are required to perform the job subtask.

On the job the student may be required to sharpen tools; in the lesson he should be required to select the proper grinding tool, select the proper angle of the tool edge, or identify a properly sharpened tool in a display of two or more tools. On the job he may be required to repair a diesel engine; in the lesson he should be required to identify repair procedures, or tools, or symptoms of proper and improper operation. Every job task requires decision making. These decisions provide the material to draw on for lesson subtasks.

This step is based on the assumption that if the student is able to perform the lesson subtasks successfully, he will probably be able to perform the job subtasks successfully. Performing these lesson subtasks constitutes the primary difference between studying a correspondence course and reading a reference book. Just as the classroom teacher requires certain activities from his students, so the correspondence course instructor requires activities from his student. The staff advisor works closely with the instructor on this stage. Because each staff advisor works with about ten instructors, he is able to carry over many ideas from course to course. The supervisor reviews the work at the end of this stage.

STEP SEVEN

The instructor designs the end-of-course (criterion) test at this point. Successful completion of the course, a prerequisite to advancement, is achieved by obtaining a passing score on the end-of-course test. Because it is a prerequisite to advancement, the test must be highly job relevant. To be useful, it should also be a reasonably good predictor of the likelihood of on-the-job success.

It is fairly easy at this stage to design such a test by selecting lesson subtasks to be carried into the end-of-course test. The test will contain 100 multiple choice items based on 100 or fewer of the lesson subtasks selected for the test outline. Because the work of ensuring that lesson subtasks are paper and pencil exercises has already been completed and reviewed, writing the actual test items is easy. As each segment of text is written later on, the instructor can design student activities and end-of-course test items for that segment of the text. By designing the student activities and end-of-course test items at the time the text is developed, we can have a greater expectation that the test item will be a useful sample of the student's understanding of the text. This stage is reviewed by the supervisor and by the staff Testing Psychologist to ensure that the outline represents a realistic sampling of course knowledge.

STEP EIGHT

The instructor must now write an outline for the text manuscript. He studies his list of job and lesson subtasks and writes a chapter by chapter outline for each of the books to be included in the course. He will organize his outline so that he can write a unit consisting of text and student activities which the student will complete and score himself. Each unit is designed to be completed in one hour or less. When the supervisor approves the course outline, the instructor begins writing his text, student activities, and end-of-course test items.

Advancement Examinations

The list of tasks "not to be taught" is subjected to the same procedure through step six. The list of lesson subtasks from the 'to be taught category is combined with the list of test subtasks from the "not to be taught" category to form a bank of subtasks for use in writing the advancement examination. Subtasks from both categories are used to produce examinations which cover all aspects of the job so that we may rank order candidates who have all been certified by their commanding officers to be fully qualified for advancement.

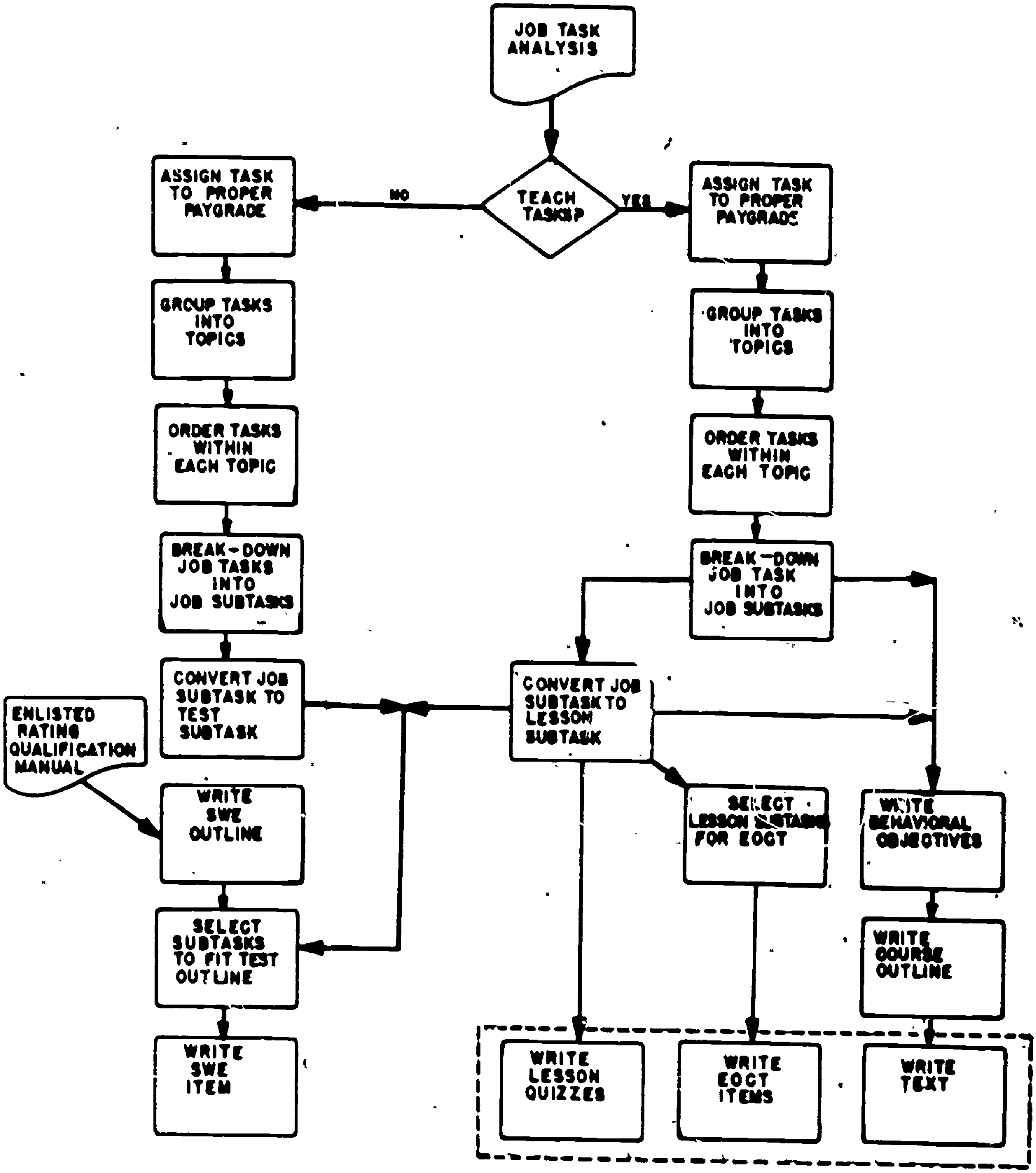
The test outline for the advancement examination is developed strictly from the Enlisted Rating Qualification Manual. Instructors may vary the weighting of various portions of the qualification, but they may not deviate from the specific job requirements laid out in the Manual. The lesson/test subtasks derived from the job task analysis, most comprising the stem and response for a multiple choice test item, are then fitted into the outline to produce the examination. For both the advancement examinations and the end-of-course tests there is little left to do beyond writing three distractors to go with the stem and response developed from the test/lesson subtask.

EPILOGUE

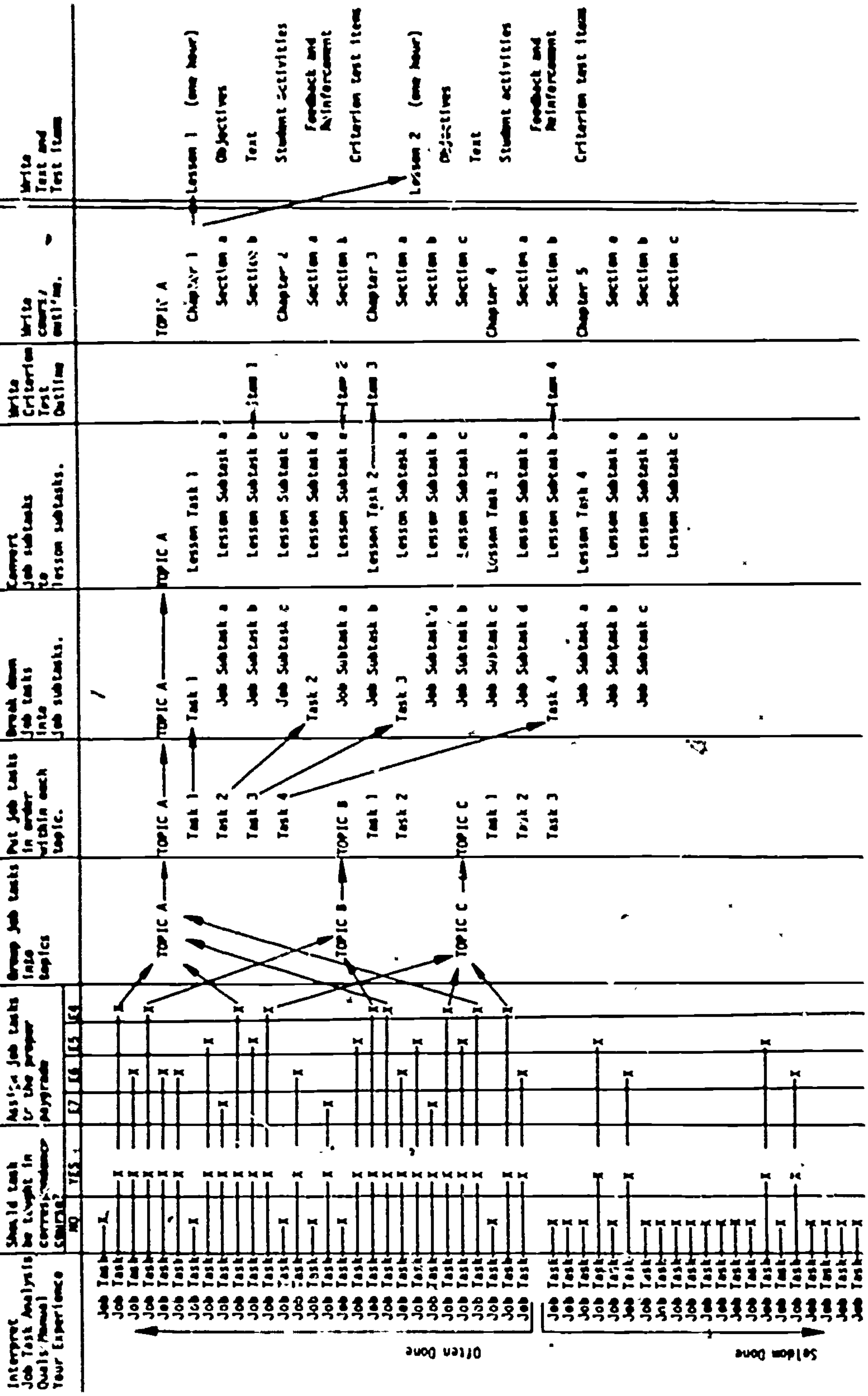
During the seventh and eighth steps we have been surprised to find some unforseen results. We had expected that the instructors would develop very good text outlines and that they would be able to easily produce very lean text manuscripts. We also expected that the quality of our student activities (lesson quizzes) and end-of-course tests would greatly increase. We did not expect, however, to find our new technician-turned-teacher to be replacing "job task" with "psychomotor activities." "Job subtask" became "enabling behavior outcome," and "job task" became "terminal behavior outcom."

Much to our delight, this process had provided our new instructors with the basis for a clear understanding of the meaning and use of behavioral objectives, and an awareness of the relationships between the psychomotor and cognitive domains of learning and performance. As the instructor proceeded from step to step in the development process, he was working with concrete tasks from the job he had previously been performing. Because the tasks were concrete and directly related to both his experience and the project he was working on, the "light" quickly clicked on. The instructor, by taking a retrospective view of what he had just done came to a rapid understanding with very little effort on anybody's part.

The final product, of course, turned out as expected. The text was lean, the tests were job relevant, and no time had been wasted. Students and candidates for advancement will be confronted with texts and tests which have been responsibly prepared under rigid conditions of accountability.


JOB TASK ANALYSIS
TEACH TASK?
NO
YES
ASSIGN TASK TO PROPER PAYGRADE
GROUP TASKS INTO TOPICS
ORDER TASKS WITHIN EACH TOPIC
BREAK-DOWN JOB TASKS INTO JOB SUBTASKS
CONVERT JOB SUBTASK TO TEST SUBTASK
ENLISTED RATING QUALIFICATION MANUAL
WRITE SWE OUTLINE
SELECT SUBTASKS TO FIT TEST OUTLINE
WRITE SWE ITEM
ASSIGN TASK TO PROPER PAYGRADE
GROUP TASKS INTO TOPICS
ORDER TASKS WITHIN EACH TOPIC
BREAK-DOWN JOB TASK INTO JOB SUBTASKS
CONVERT JOB SUBTASK TO LESSON SUBTASK
SELECT LESSON SUBTASKS FOR EOCT
WRITE BEHAVIORAL OBJECTIVES
WRITE COURSE OUTLINE
WRITE LESSON QUIZZES
WRITE EOCT ITEMS
WRITE TEXT

116



Interpret Job Task Analysis Quals Manual Your Experience
Should task be taught in correspondence course?
NO
YES
Assign job tasks to the proper paygrade
E7
E6
E5
E4
Group job tasks into topics
Put job tasks in order within each topic.
Break down job tasks into job subtasks.
Convert job subtasks to lesson subtasks.
Write Criterion Test Outline
Write course outline.
Write Text and Test Items
Often Done
Seldom Done
TOPIC A
TOPIC B
TOPIC C
Lesson 1 (one hour)
Objectives
Text
Student activities
Feedback and Reinforcement
Criterion test items
Lesson 2 (one hour)

TASK ANALYSIS:
THE BASIS FOR PERFORMANCE TEST AND INSTRUCTIONAL DESIGN

Robert N. Johnson and 1LT James N. Richmann
U. S. Army Institute of Administration

Recently both the civilian and military educational communities have become enamored with the concept of educational accountability in vocational education and job training. Simply stated, educational accountability requires specification of the desired results of the system, measurement of the instruction in terms of these results, and a continued search for ways to lower costs or imporve the program. The foundation for attaining accountability is task analysis, the process of specification of training outcomes in terms of job actions, job conditions, and results of job performance. Under this philosophy, task analysis is the basis for development of the performance tests which will be used to measure instruction and for the design of the instruction itself. The cost and quality of this instruction, therefore, is tied directly to the quality of that task analysis. But what is the quality of our current task analyses? Do they accomplish the purposes for which they are intended? Dr. Charles Jackson of the U.S. Army Armor School in the report of an Instructional Technology Study Group observed that "personnel performing task analysis activities were preparing task lists of imprecise tasks and were not analyzing these tasks in sufficient detail to facilitate instructional design." This paper addresses a methodology for the use of a well documented task analysis in performance test and instructional design.

In addressing the problems inherent in task analysis it is important to identify a conceptual model for the efficient use of task analysis information in the instructional design process. Such models are common and almost all agree as to what task analysis should accomplish. A typical model, simplified to chart the relationship of task analysis to other instructional design is shown on this transparency (see Figure 1).

INSTRUCTIONAL DESIGN PRODUCTS

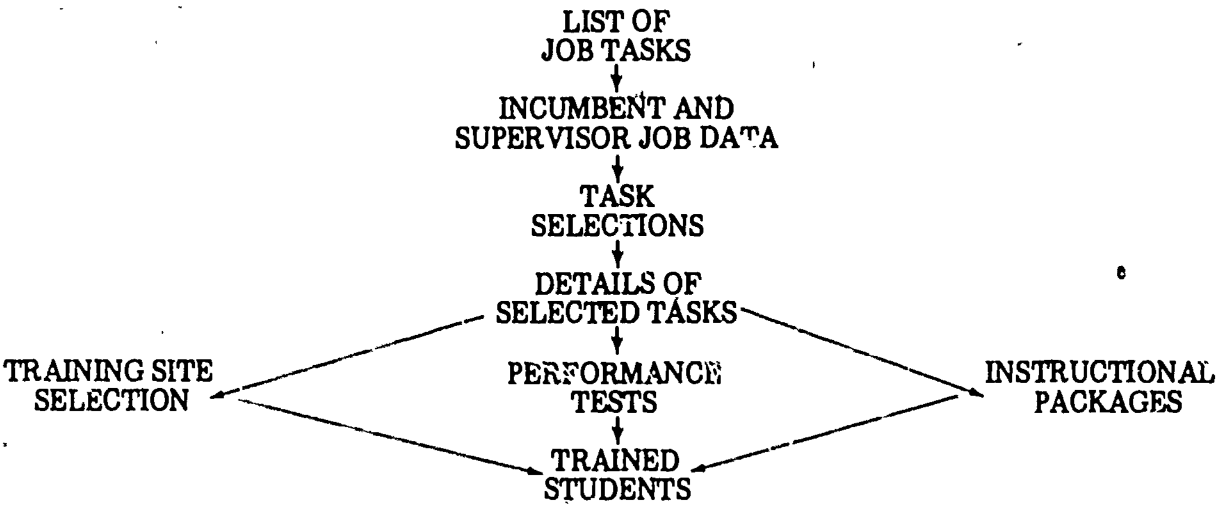


Figure 1

The first requirement is to make a list of tasks performed by job incumbents. Second, we need to collect job data from job incumbents and supervisors which will permit a cost-effective selection of tasks for training and testing. Third, we need to analyze each task into the detail required for selection of training site, design of performance tests and development of instructional packages or lessons.

Examination of these products indicates that two levels of task specificity are required in instructional design (see Figure 2).

LEVELS OF TASK DETAIL

DETAIL	USED FOR
Short Task Statement	Task Inventory Data Collection Task Selection
Detailed Task Description	Training Site Selection Test Design Instructional Package Design

Figure 2

First, short terse statements of job tasks are used to make the task inventory and to collect the data necessary for task selection. Task statements which are long or detailed do not facilitate data collection and result in a cumbersome task list. Second, detailed descriptions of each task are used to select the training sites, design the performance tests, and develop the instructional packages. The terse task statements used to collect job data do not contain sufficient detail for these later functions. They may tell you what is done, but do not tell you how. To select a training site, design a performance test, or develop an instructional package, the designer needs to know the cues to performance, the elements of performance, the conditions which affect performance, and the results of acceptable task performance.

Instructional designers have recognized these two different levels of detail, but have not recognized the relationship between the two.

With respect to the need for short terse task statements, the major problems has been levels of specificity. Task inventories have been prepared which contain statements which are often too broad to permit further detailed analysis or are too narrow to be considered independent tasks. As a result, data is collected and selections are made only to find out that the original task statements are inadequate to serve as the basis for future steps in instructional design.

For examples of this problem of level specificity, consider these examples (see Figure 3) extracted from the task inventory for the military job of unit First Sergeant.

EXTRACT OF TASK LIST

JOB = COMPANY FIRST SERGEANT

SUPERVISE UNIT ADMINISTRATION SAFEGUARD CLASSIFIED MATERIALS	TOO BROAD
SELECT A DETAIL USING A DUTY ROSTER INVENTORY CLASSIFIED DOCUMENTS	ACCEPTABLE
DETERMINE CAUSE OF SOLDIER'S ABSENCE LABEL CLASSIFIED MATERIAL	TOO NARROW

Figure 3

Some task statements are so broad as to preclude detailed analysis since the exact parameters of the task are not defined. Others are so narrow that analysis reveals they are really elements of a larger task. Consider the first two task statements on the list. These tasks have a different meaning and interpretation for each of us. Each possible interpretation would result in a different detailed analysis of the task and thus change both the training and test content. If we do not catch this type of task prior to the collection of job data, then problems will arise in the selection of tasks for training. Varying levels of specificity distort values of "percent performing" and other statistics calculated from cumulative job data. Even the raw data for this task will be suspect since no one can be certain which portion of the responses pertain to the various interpretations of the task. In effect, we are not in any better position to design training than we were when we used subjects rather than tasks as the basis for instructional design.

Now, conisder the last two task statements on the list. A cursory examination of these tasks shows no real problems, but a detailed analysis reveals that these tasks are really part of a larger, more complete and cohesive, task. It makes little sense to collect job data on these elements of performance when detailed analysis of the larger task may establish that total task cannot be adequately performed without that element. In addition, including task elements like these in the inventory increases the administrative burden of data collection.

Our objective is to write task statements at the level of specificity which represents a meaningful "whole" on the job from the viewpoint of the job incumbent. The only solution to this problem of task specificity is a careful edit of the task inventory prior to data collection, combined with proper use of iterative feedback from the further detailed task analysis. Management must realize that no design product, including a task inventory, is initially perfect. The "trial-test-revise" procedures of validation of instructional materials are applicable during the process of task analysis as well. If, during the detailed analysis of a task statement we find the original level of specificity was too broad or too narrow, then the task inventory must be changed.

In editing the list prior to the collection of job data, the analyst must carefully consider each statement and determine not only whether it is a task, but also whether or not it is written at a level of specificity which facilitates further detailed analysis. Although, we utilize the commonly accepted definitions of a task, we have added a new dimension. In addition to the requirements that a task is a highly specific unit of job activity stated in job terms with an action verb and an object, must have a definite beginning and a definite end, must have at least one cue or stimulus which, in the real world signals the incumbent to perform that task and must be observable and measurable, we insist that a task must be the smallest unit of job activity performed for its own sake in the eyes of a job incumbent in the job situation (see Figure 4).

A TASK MUST BE THE SMALLEST UNIT OF JOB ACTIVITY DONE FOR ITS OWN SAKE IN THE EYES OF THE JOB INCUMBENT IN THE JOB SITUATION

Figure 4

It is the smallest unit of meaningful performance to the worker. This is the key distinguishing characteristic between a task and an element of a task. For example, a mechanic does not remove the wheel and tire from a vehicle for the purpose of removing the wheel and tire. The removal is made in order to accomplish one of several tasks, e.g., "rotate the tires," repair a flat," "install new tires," etc. These latter statements are tasks because they are done for their own sake in a job situation. Each of them requires, as an element of performance, the removal of the wheel and tire from the vehicle. By including "done for its own sake in a job situation" as the major characteristic of a task as opposed to an element, we permit differentiation among tasks and elements. By including "done for its own sake in a job situation" as the major characteristic of a task as opposed to an element, we permit differentiation among tasks and elements. By including "in the eyes of the job incumbent" we recognize that a statement which is a task at one job level may be a duty or only an element at another job level. By including "the smallest unit of meaningful performance" we recognize that duties and jobs etc., are meaningful units of performance, but do not furnish sufficient detail to permit further analysis. While judgement of this criteria for a listed task statement is subjective, the use of Robert Mager's "Hey-Dad" test* is a fairly good indicator of whether or not the statement is a task or an element. In this test one imagines the supervisor asking the job incumbent "What are you doing now?" If the job incumbent could be expected to answer with the listed statement, then the statement is probably a task.

The preceding discussion emphasized the first requirement for specificity in task analysis—the need for short, terse task statements which represent meaningful "wholes" to job incumbents. Now, we would like to shift the discussion to the second requirement—the need for detailed task descriptions which provide the basis for design of tests and instructional packages. In relationship to the overall model of instructional design (see Figure 1) the production of these detailed task descriptions follows job data collection and task selection. The position of the detailed analysis in the process is an important factor in establishing a logical and cost effective sequence to the overall instructional design system. It is logical to perform the detailed analysis at this point since the information derived is not required earlier in the process. It is cost effective since it precludes detailed analysis of tasks which may be eliminated during the task selection procedure. The detailed task analysis is still at this stage, divorced from training. This is as it should be since we are concerned with how the task is performed in the real world, not how it will be performed during training. One of the gravest errors we could make during design would be to base our detailed analysis, and hence our tests, on the content of the training rather than on the actual job requirements. For this reason, we must separate the detailed task analysis from the training analysis which results in design of lessons, instructional packages, or media materials.

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*Mager, Robert F., Goal Analysis, Belmont, CA. Fearon Publishers, 1972, page 30.

The central problem in developing a detailed task analysis is to find a way to document the work of the analyst. While forms, procedures, and the like are not ends in themselves, the most brilliant thought, if not carefully recorded for future reference, is lost and useless. Good documentation should be flexible, easy to understand, easy to reference, and have no unnecessary components. Since documentation is only a tool it should be easy and cheap to construct and reproduce. Good documentation should direct the thinking of a mediocre analyst to discover the critical aspects of the task, but not restrict the thinking of the good analyst to discover imaginative new solutions to old problems. Because tasks are different, format should not dictate the analysis procedure. To a large extent, therefore, the usefulness of the detailed task analysis, and hence the quality of the following instructional design products is dependent on the type of documentation used.

In the U.S. Army Institute of Administration we have had considerable success documenting the detailed task analysis with a format we call a Task Structure Analysis to differentiate it from activities concerned with the task statement only. On the Task Structure Analysis form we document four major aspects of task performance (see Figure 5).

TASK STRUCTURE ANALYSIS

DOCUMENTATION OF:

1. CUES
2. CONDITIONS
3. ELEMENTS OF PERFORMANCE
4. RESULTS

Figure 5

First, we record the cues which initiate the task. Second, we state the elements of performance in their logical sequence. The elements of performance are either the steps in the execution of the task, or the decisions made during performance which alter the sequence of the process. Next, in relation to each of the elements of performance we document the conditions which are associated with performance. These conditions may be tools, references, job aids, environmental or attitudinal factors which affect performance. Finally, we record the characteristics of the results of adequate task performance. These results of task performance may be documented either in terms of characteristics of an acceptable product, key steps in an acceptable process, or in terms of known errors in execution of the process.

At this time I would like to pass out a completed Task Structure Analysis to give you an example of the format and procedures used to record the detailed analysis (pass out Figure 6). The task documented on this example is "Select a Detail Using a Duty Roster." The cues which initiate task performance are first listed in block 7 on the form. You will notice that each cue is associated with a response consisting of execution of one of the elements of task performance. Most frequently, all cues are associated with the first element of performance, but this is not always the case. Some cues, for example, may complicate the situation and require extra steps or decisions prior to performance of the "main stream" elements, other cues may result in by-pass of earlier steps in the process. One of the major advantages of this form is its flexibility in showing this type of relationship among the cues.

TASK STRUCTURE ANALYSIS	1. DATE: 1 JUL 1975	2. PAGE 1 OF 4 PAGES

3. JOB/MOS: MOS: VARIABLE	4. DUTY: First Sergeant

5. TASK STATEMENT: (STATE AS AN ACTION VERB WITH AN OBJECT.) Select A Detail Using A Duty Roster (DA Form 6)	6. TASK NUMBER

7. CUES: (LIST EVENTS WHICH INITIATE TASK PERFORMANCE.)			GO TO STEP	NECESSARY CONDITIONS
1. Oral or written requirement to select a recurring detail.			1	#, Date & Type of Detail.
2. Recurring requirement for a detail (SOP).			1	
3. Change in status of anyone on duty roster after publication of detail roster.			30	Notification of Change in Status.
8. DECISIONS AND/OR STEPS: (STATE DECISIONS AS YES/NO QUESTIONS.) (STATE STEPS AS SUBTASKS.)	DECISIONS YES	DECISIONS NO		
1. Do you have a duty roster for this detail?	2	25	x	All Active Duty Rosters.
2. Secure Duty Roster.	x	x	3	Appropriate Duty Roster, in Files in Office.
3. Are all columns of the roster already used.	25	4	x	
4. Annotate date of detail to next open column.	x	x	5	
5. Are there any personnel to be added to the roster?	23	6	x	Notes Indicating Required Additions
a. New arrivals (ASGD or ATCHD).				Notification of Release from ED.
b. Permanent release from ED.				
6. Are there any personnel to be deleted from the roster?	24	7	x	Notes Indicating Required Deletions
a. Departures (reassignment or Rel from ATCHD).				Notification of New ED.
b. New permanent ED.				
7. Any authorized non-availables? (LV, PASS, SD, TDY, SICK-LINE of Duty).	8	9	x	Notes Indicating Status of Individuals.
8. Post "A" opposite name under date of detail.	x	x	9	

ADMINCEN FORM 1297, 1 JUL 75 (ATSG TE) PREVIOUS EDITIONS MAY BE USED.

Figure 6

TASK STRUCTURE ANALYSIS	PAGE 2 OF 4 PAGES	DECISIONS YES	DECISIONS NO	GO TO STEP	NECESSARY CONDITIONS
9. Any unauthorized non-availables? (AWOL, SICK-SLD, Confinement, Arrest, other reason due to own misconduct).		10	11	x	Notes Indicating Status of Individuals.
10. Post "U" opposite name under date of detail.		x	x	11	
11. Any eligibles who cannot be selected due to previous detail or other duty?		12	13	x	Other Deatail Rosters, Knowledge of Other Duty Requirements.
12. Post "D" opposite name under date of detail.		x	x	13	
13. Is this a consolidated roster?		14	15	x	Consolidated or Non-consolidated Roster.
14. Select previous column (if available) pertaining to category of detail (weekend/holiday of weekday).		x	x	15	
15. Identify (next) highest number in the selected previous column (if available) without an "A", "U" or "D" under date of detail.		x	x	16	
16. Is there more than one Soldier with the same highest numbe		17	19	x	
17. Does the (remaining) detail requirement equal or exceed those identified?		19	18	x	
18. Selecc sufficient individuals to fill detail requirement by going down from top of roster.		x	x	19	
19. Place hatched lines, in pencil, opposite selected name(s) under date of detail.		x	x	20	Pencil.
20. Are more individuals required to fill detail requirement?		15	21	x	
21. With the exception of those posted with "A", add 1 to previous column running total and post under date of detail (use red pencil for weekend/holiday columns on consolidated rosters).		x	x	22	Red Pencil, Black Pencil.
22. File Duty Roster and publish Detail Roster (separate tasks).		x	x	EOT	
23. Annotate name to bottom of roster and line out previous detail columns, annotate reason on reverse side.		x	x	6	
24. Delete name from roster and annotate reason on reverse side.		x	x	7	

TASK STRUCTURE ANALYSIS	PAGE 3 OF 4 PAGES	DECISIONS YES	DECISIONS NO	GO TO STEP	NECESSARY CONDITIONS
25. Secure blank Duty Roster.		x	x	27	Blank Duty Roster
26. Fill in nature of duty, organization, and from date.		x	x	27	
27. Identify all eligibles for entry on roster.		x	x	28	Unit Roster or Previous Duty Roster (Filled).
28. Enter names on roster alphabetically by pay grade, listing rank (SFC, SP6, SSG, CPL, etc)		x	x	4	
29. Post changes to duty roster.		x	x	30	
30. Is there any change in status of selected individuals in the detail roster which could preclude their pulling the detail?		31	EOT	x	Notification of Change in Status of Individuals in Published Detail Roster.
31. Erase hatched lines pertaining to those individuals and post new status.		x	x	15	Eraser.

PRODUCT CHARACTERISTICS:

1. List of selected individuals for detail

   a. Proper number.

   b. Correct names.

2. Properly posted duty roster

   a. Correct date of detail in column heading.

   b. "A" posted by appropriate name.

   c. "D" and correct number posted by appropriate name.

   d. "U" and correct number posted by appropriate name.

   e. Hatched lines by appropriate names.

   f. Correct numbers posted by all other names.

   g. Correct names added to roster.

   h. Correct names deleted from roster.

TASK STRUCTURE ANALYSIS	PAGE 4 OF 4 PAGES	DECISIONS YES	DECISIONS NO	GO TO STEP	NECESSARY CONDITIONS
i. Proper annotations made on reverse of roster. j. Correct heading on new rosters. k. Personnel listed alphabetically by rank on new rosters. l. Red entries for weekend/holiday details on consolidated rosters.					

ADMINCEN 1997

Once at least one cue has been identified the designer may begin to list the elements of performance in block 8. Those of you who are familiar with decision flow charts or logic trees will recognize that this format is nothing more than a flow chart in narrative form. Instead of using boxes and arrows we used the associated "decision-yes-no" and "go-to-step" blocks to establish the relationships among the elements of performance. Again, the format is designed to maximize flexibility for the designer. You may use this form to document a stimulus-response table, a linear list of sub-tasks, or a decision table. In our experience, however, most real world tasks have considerable branching in that varying conditions and cues affect the manner in which the task is performed. Sorting out the logic of these interactions is a time consuming process, but one which yields considerable insight. Seldom is a simple list of subtasks sufficient to detail the complexity of real world task performance. The task Structure Analysis form forces the designer to consider the interrelationships among conditions, cues, and elements of performance. Directly next to the listing of elements of task performance the designer is asked to document the conditions associated with each step or decision. This documentation is especially important later in test design. At the end of the Task Structure Analysis we document the characteristics of the desired results of task performance. When the task does result in a tangible product we are most interested in a listing of the characteristics of that product. Again, this is motivated by our needs in test development. Characteristics of the product are especially important to us because our design methodology stresses the use of product measures whenever possible. When no tangible product is available, a listing of key steps or known errors in the process of task performance may be used. This listing of process steps or errors then becomes the basis for a successful process measure to test competency.

You are all familiar with the concepts of test validity and reliability but the concept of test fidelity refers to how closely the requirements of the test match the requirements of task in the real world. The assumption is that the higher the fidelity of test, the higher the probability that the test has content validity. Many of you may have already recognized that the Task Structure Analysis represents the highest fidelity test which could be used to measure competency. If an examinee were presented with all possible cues and conditions, performed all steps and decisions, and produced a product with all of the desired characteristics, we could certainly certify his competency.

With the level of detail included in the Task Structure Analysis the instructional designer has a firm foundation for the design of both the performance test and the instruction itself. Some approaches to instructional systems design indicate that the test and the training should be deisgned, simultaneously but separately, direct from the task analysis. While we do not object to this philosophy, our limited resources normally require that the same instructor perform both functions. Accordingly we advocate design of the performance test, prior to and independent of, the design of the instructional package.

Our approach to test design is relatively straight forward. The first step is to identify the environment in which the test will be conducted. Tests may be conducted in a classroom, in a laboratory or other simulated job environment, in an actual job setting, or as part of a correspondence course. Each of these environments present a different set of constraints which must be addressed in the design of the instruments. Once the environment has been established the designer closely examines each cue and condition associated with the process as shown on the Task Structure Analysis.

This examination results in a listing of the real world constraints which preclude full fidelity testing of the task. The test designer then attempts to develop a simulation for each clue of condition precluded by the testing constraint. If realistic and cost effective simulations cannot be designed the elements of performance associated with those cues or conditions are merely eliminated from the test. As a result of this process a modification of the original detailed analysis emerges which represents the highest level of fidelity at which the task could be tested. It is at this point, and no earlier, that the constraints which all test designers consider, come into play. Set up time, time to administer, and time to score and grade are of primary concern to all instructors since they represent time and effort of both the instructor and the student. Consideration of these three additional constraints may again require further reduction in the level of fidelity of the performance test. In the end, however, the final design should represent the highest fidelity test which can be designed within existing cost constraints.

It should be noted that to this point I have not mentioned the Student Centered Performance objective often referred to as the instructional objective. Although many writers advocate the writing of the instructional objectives direct from task analysis, we take the position that the instructional objective is nothing more than a description of the performance test which the student must pass in order to demonstrate competency. Accordingly, we advocate preparation of that objective immediately following the design and validation of the performance test instrument. At this stage, the conditions, actions, and standards are known and the instructional objective can be written to clearly outline for the student exactly what is expected of him. The possibility of a disconnect between the objective and test is also avoided.

Our approach to instructional design, although not fully developed at this point in time, also envisions the Task Structure Analysis as the foundation document. By examining each element of performance listed in the analysis and asking the question "What must the student know, or be able to do, to perform this step or make this decision," the designer can, with relative ease, prepare a listing of skills and knowledges inherent in the task. An analysis of the target student population and the prerequisites courses and blocks of instruction can then be made to determine which of these skills and knowledges are already within the repetoire of the prospective student. Once these have been eliminated, the remainder represent the content of the instructional package to be designed. If we are to utilize a functional context approach to instructional design, the sequence of instruction is dictated by the sequence outlined in the Task Structure Analysis with knowled nd skills taught as they become necessary to accomplish each element of performance. Our a ach to the selection of methods and media is simply to utilize the cheapest approach which accomplishes the instructional objective as measured by validation of the instructional package or lesson using the performance test designed earlier as the criterion.

In summary we have found that cost effective instructional design required task specification at two different and distinct levels of detail. First short terse task statements written at a level of specifity which facilitates not only data collection and task selection, but which also facilitate further detailed analsysis. Second, the detailed analysis of selected tasks into cues, conditions, elements and results of performance to facilitate performance test and instructional design.

The enormity of the front end analysis effort required to provide a firm basis for the design of vocational education or job training courses is indeed staggering but, as professionals, we must face the issue directly if we are ever to maintain that we are following the precepts of educational accountability.

Summary of Symposium Evaluation

Willie H. Thomas
The Center for Vocational Education

In an effort to become aware of the opinions participants had relative to the Symposium on Task Analyses/Inventories, the one-hundred and fifty-eight (158) participants were asked to evaluate the symposium by responding objectively and/or subjectively to several questions concerning: (1) the benefits they acquired as a result of attending the symposium; (2) suggestions for future programming of symposiums.

Eighty-three (53 percent) of the 158 participants responded to the evaluation survey. The results of an analysis of those responses are summarized below.

Primary Objectives for Attending Symposium

The following is a condensed listing of the participants objectives for attending the symposium. The participants objectives reflected the many diverse backgrounds (i.e., business, industry, universities, public and private organizations and labor) they represented. The primary objectives were: (1) to become knowledgeable of specific methodologies and evaluation techniques; (2) to learn about the identification and development of curriculum and performance-based objectives for teaching and training purposes, (3) to secure an overview of the state-of-the-art; (4) to gain expertise in developing, compiling, and interpreting task analysis data; and (5) to determine how to utilize task analyses/inventories to accomplish various training goals and objectives.

Rating of Achievement of Objectives

N = 83

Well Achieved	Moderately Achieved	Mostly Achieved	Not Achieved	No Response
22	30	18	6	7
26.5%	36.1%	21.7%	7.2%	8.4%

129

Suggestions for Future Symposium Topics

The following condensed statement. indicate participants opinions as to what future symposium topics on Task Analyses/Inventories should comprise. The topics that appeared most frequently were. (1) how to use task analyses, inventories for curriculum and instructional content development; (2) the practical application of task analyses (i.e.. how to utilize the information efficiently and effectively for those job categories for which analyses have been developed, (3) "show and tell" to reflect uses of task analyses in job performance/evaluation, and (4) specifics on how to derive job data, how to use various data gathering techniques, and how to select devise task analysis methodology considering general parameters such as selection criteria.

Suggestions for Changes in Physical Facilites, Travel Arrangements, Meals, Lodgings, Length of Symposium, Schedules and Speakers

Participants reactions with respect to physical facilities, travel, arrangements, meals, and lodging evidenced very few complaints. However, there are two areas, in particular, that most of the participants were dissatisfied with. (1) inadequate audiovisual equipment and insufficient material provided by speakers, and (2) the number of speakers programmed for the scheduled days/time allowed for the symposium.

Comments as Constructive Criticism of Symposium

The following participants commen s should be considered inclusive and/or in keeping with all the opinions given by each individual, bu reflect the general opinions held by participants; (1) due to the diversity of group interests, in-service training sessions and workshops should be conducted with homogeneous groups (i.e. with educators, business, industry, management and personnel directors) for better understanding of how each interest group could utilize task analyses/inventories for the most significant to their work, (2) include more information on name tags, such as, the organization, institution or agency being represented, to allow for common interest mixing and the enhancement of more group and interpersonal interaction, and (3) future symposiums should be divided into two distinct groups (i.e., divide the group into those individuals interested in job analysis and those who are more interested in content analysis.)

General Rating of Symposium

N = 83

Excellent	Good	Fair	Poor	No Response	Total
18	43	13	5	4	83
21%	51.8%	15%	6%	4.5%	

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